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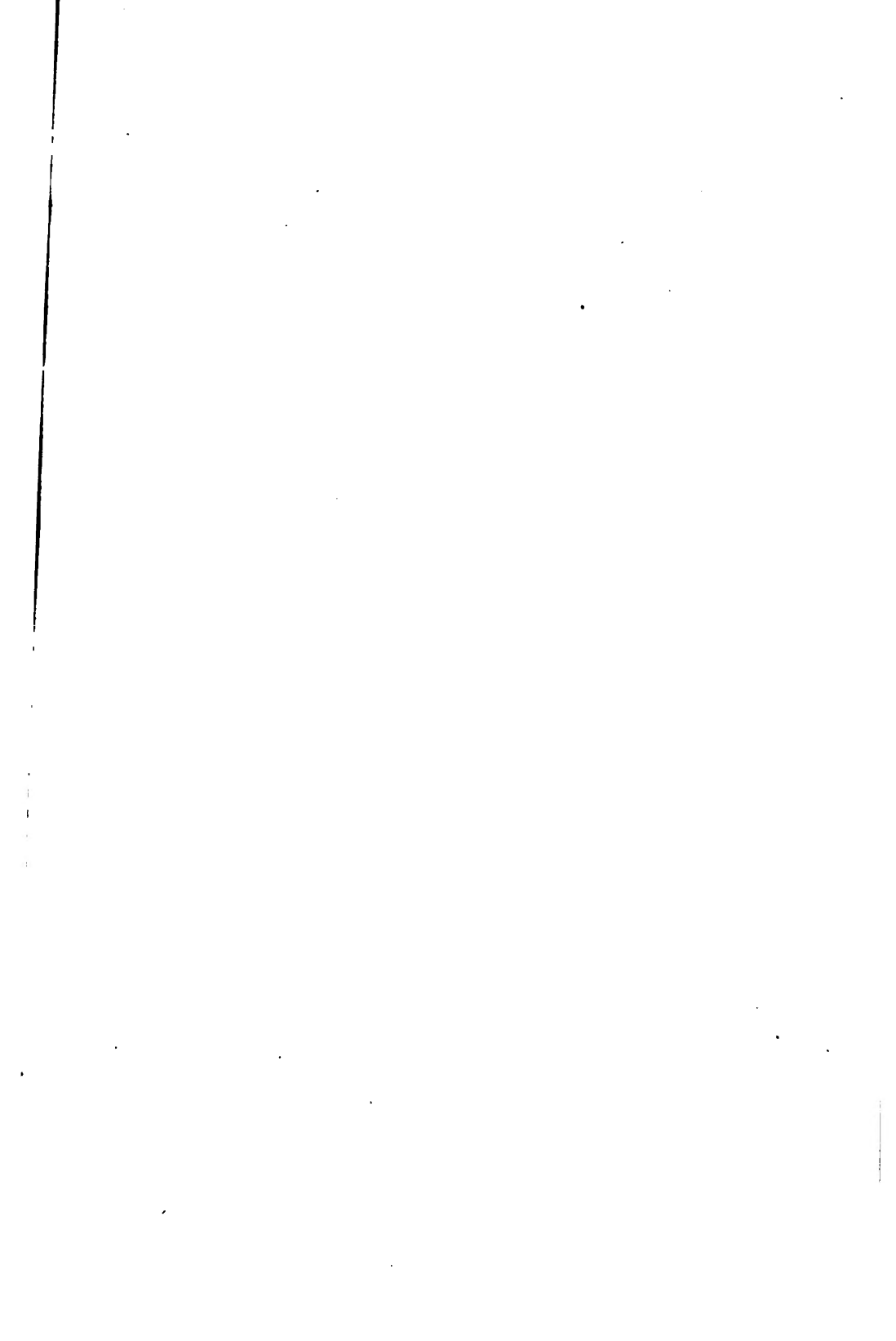
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REPORT
OF THE
NEW JERSEY STATE
MUSEUM
1906.

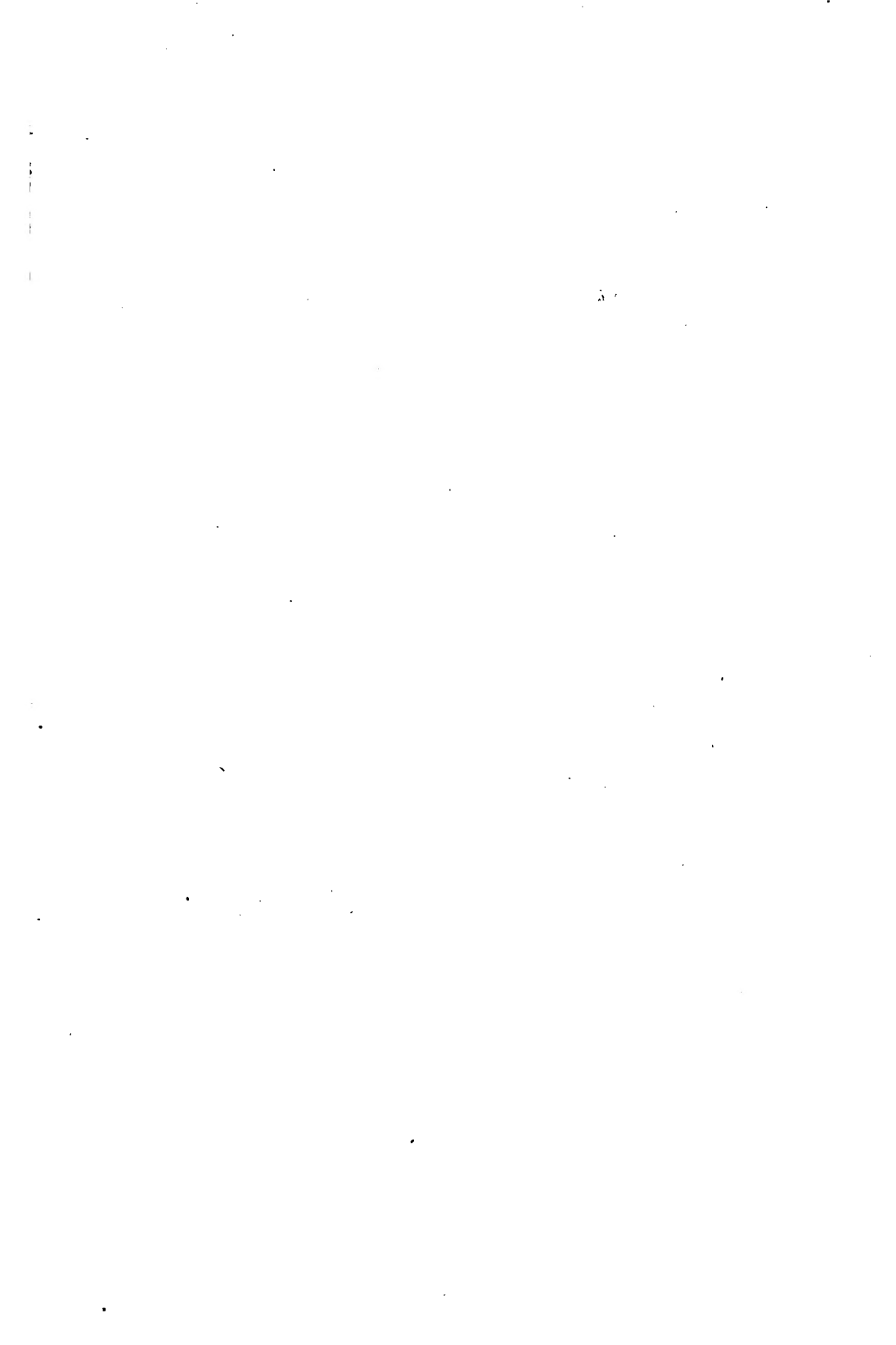
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FROM
New Jersey State Museum
COMPLIMENTS OF
S. R. MORSE,
CURATOR.

may
all plates present









COMMISSIONERS AND CURATOR OF NEW JERSEY STATE MUSEUM, 1906.

1. C. J. Baxter.
3. Prof. E. H. Voorhees.
5. S. K. Robbins.

2. H. B. Kummel
4. Hon. Wm. J. Bradley.
6. S. R. Morse, Curator.

ANNUAL REPORT
OF THE
New Jersey State Museum

Including a list of the Specimens received
during the year

FINANCIAL REPORT

With a Report of the

AMPHIBIANS AND REPTILES OF NEW JERSEY

and a

SUPPLEMENT TO THE "FISHES OF NEW JERSEY."

FULLY ILLUSTRATED

1906

TRENTON, N. J.
MacCrellish & Quigley, State Printers.

1907

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N454
1906

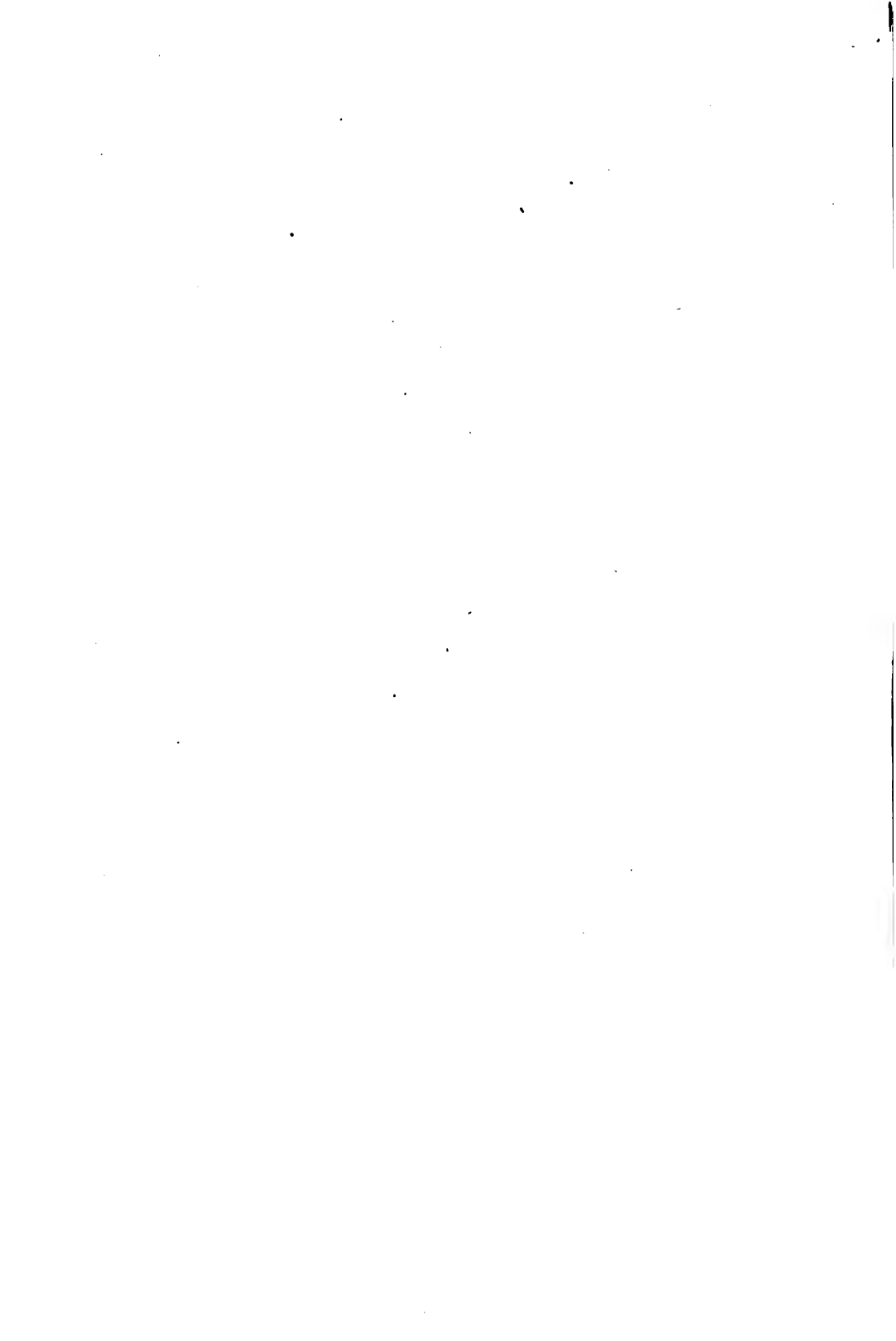
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PART I.

(3)

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Commissioners of the New Jersey State Museum.

STATE SUPT. OF PUBLIC INSTRUCTION, CHARLES J. BAXTER, *President.*

STATE GEOLOGIST, HENRY B. KÜMMEL, *Secretary.*

PRESIDENT STATE BOARD OF AGRICULTURE, E. B. VOORHEES.

PRESIDENT OF THE SENATE, WILLIAM J. BRADLEY.

SPEAKER OF THE HOUSE OF ASSEMBLY, SAMUEL K. ROBBINS.

SILAS R. MORSE, *Curator.*

Heds of the Several Departments of the New Jersey State Museum.

C. J. BAXTER, STATE SUPERINTENDENT OF PUBLIC INSTRUCTION,
Educational.

E. B. VOORHEES, RUTGERS COLLEGE,
Agriculture.

HENRY B. KÜMMEL, STATE GEOLOGIST,
Geology.

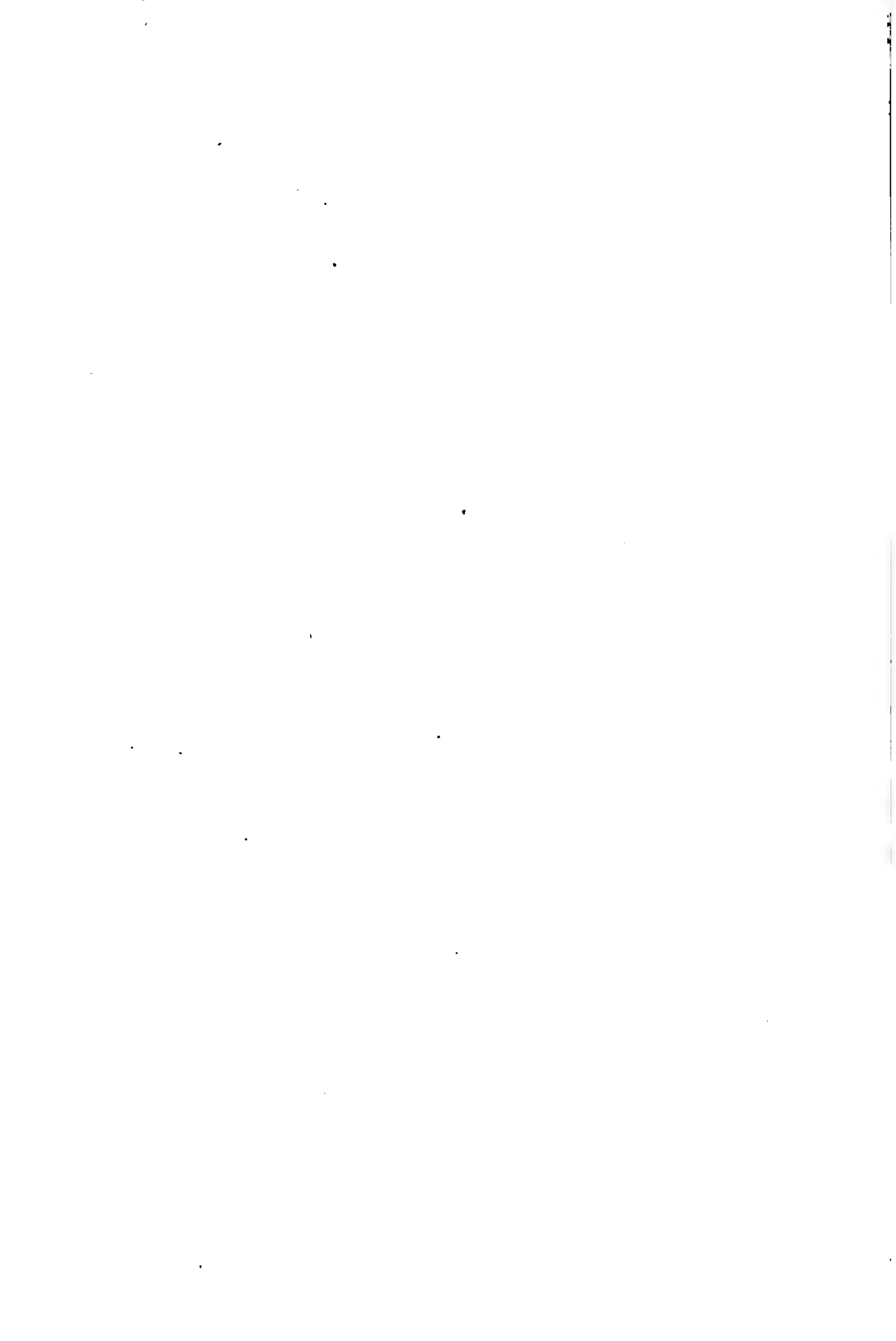
JOHN C. SMOCK, Ex-STATE GEOLOGIST,
Forestry.

AUSTIN C. APGAR, STATE NORMAL SCHOOL,
Birds and Botany.

JOHN B. SMITH, STATE ENTOMOLOGIST,
Entomology.

JAMES T. MORGAN, DEPUTY OF BUREAU OF LABOR STATISTICS,
Manufactures.

WILLIAM H. WERNER, *Taxidermist of Museum.*
HERBERT M. LLOYD, SECRETARY OF GEOLOGICAL SURVEY,
Archæology.



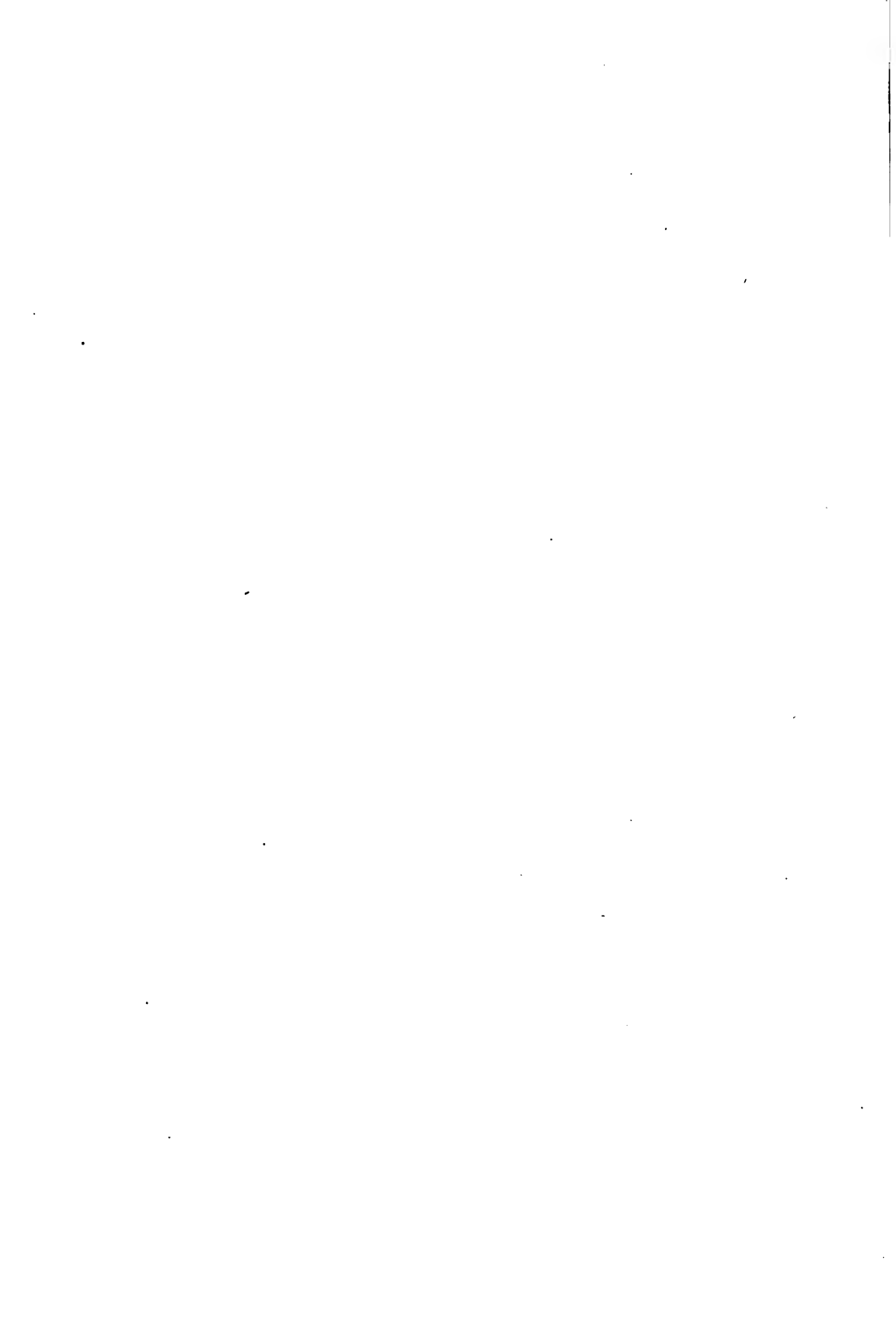
Letter of Transmittal.

TRENTON, N. J., November 30th, 1906.

*To the Honorable Edward C. Stokes, Governor of the State of
New Jersey:*

SIR—I have the honor to present, for the Commissioners of the New Jersey State Museum, the Annual Report, including the Report of the Amphibians and Reptiles of New Jersey and a Supplement to the "Fishes of New Jersey."

SILAS R. MORSE,
Curator.



The Curator's Report.

Owing to the success of our last report, of 1905, which was almost wholly devoted to the "Fishes of New Jersey," we have concluded in the present volume to continue the "Fishes of New Jersey" as a supplement, and take as our principal subject the "Amphibians and Reptiles of New Jersey," prepared by the same author, also to be fully and similarly illustrated. The Museum Commission is pleased to know that the last report has been very favorably received by the State officials and the public. We have received, and are still receiving, many complimentary letters. Great credit is due to Mr. Fowler for the excellent manner in which he has presented the subject. Messrs. MacCrellich & Quigley, printers, deserve much credit for their painstaking efforts to make it a success.

We feel that this work will be creditable not only to the New Jersey State Museum, but to its Commission and all connected with it. With the completion of the present volume a complete account of the interesting cold-blooded vertebrates, so far as our knowledge will permit at present, is for the first time offered. We trust, if for this alone, our work will claim a generous indulgence on the part of the public, and fill a long apparent want.

The Curator and the Commission now feel that their aim to establish a first-class educational museum is beginning to be appreciated by the State officials and the public. Although with the work just begun they feel much has been accomplished in a short time and with a very small outlay of money by the State. Their purpose will still be to continue on the same lines as carried on thus far.

10 REPORT OF NEW JERSEY STATE MUSEUM.

GEOLOGICAL DEPARTMENT.

The Geological collection contains specimens of nearly everything of geological interest to be found in the State. They are so arranged that they may easily be seen and studied. This is facilitated by a card system, having been prepared during the past year, which required much care and work. Under this system it is easy to name or find any desired specimen.

BIRDS.

The collection of the New Jersey birds, nests and eggs is quite complete, considering the short time since the collection was started. It is so arranged that the specimens may easily be seen and studied. We are making a separate exhibit of the nests and eggs, besides those used in the groups of birds.

WOODS.

The collection of woods is quite extended. The case showing the three cuts of each specimen, transverse, radial and tangential, and so arranged in the cabinet, was invented by the Curator of the Museum. It is very interesting and proves most satisfactory. The thin slices of wood are placed between two glasses on sliding frames so that they may be brought into the light and thus seen to the best advantage and greatly facilitate their study. We have found nothing in this respect more workable. This case was first exhibited at St. Louis in 1903, and for it the Museum received a gold medal.

FISHES.

The collection of mounted fishes, though not complete, is one of the best of its kind to be found, and much praise has been given by competent judges of their value from an educational point of view.

MAMMALS.

The collection of mammals is receiving attention. Many of them are arranged in groups, with old and young. These groups have additional value in instructing the public with their life-histories to some extent. They also serve to stimulate more interest in this group of animals. We have added during the past year several fine groups. That of the beaver is especially noteworthy. It has the stump from which the beaver cut the tree and the chips.

INSECTS.

We have one of the most interesting collections of insects from New Jersey that may be found. We have added only a few specimens the past year, but the collections are quite complete. We have brought from the New England States examples of the most destructive moths, those of the Gipsy and Brown-tail. The public may be able to detect and destroy them when they make their appearance, as seems inevitable.

MOSQUITO EXHIBIT.

Some additions have been made to the exhibit "How to get rid of the Mosquitoes." This has been studied by many persons from all over the country.

Nothing new has been added to the School Exhibit. In fact, the largest part of this had to be packed away to give way for the new addition being built to the State House, and cannot now be seen. We do not know when we shall again be able to place it before the public, as no provision is being made in the new rooms for it. This is a very important part of our Museum, and should be provided for in some way at an early day. New Jersey has the most complete display of this kind in the United States, as we have the work of the schools shown at the Philadelphia Centennial Exposition in 1876, that of New Orleans in 1884-1885, the Columbia Exposition at Chicago in 1893, the Pan-

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American Exposition at Buffalo in 1901, the South Carolina Inter-State and West India Exposition in Charlestown 1901-1902, and the Universal Exposition at St. Louis in 1904.

With the educational work from these expositions any one is enabled to make comparisons and see what advancement the New Jersey public schools have made during that time.

At the coming Ter-Centennial Exposition to be held at Jamestown, Virginia, to commemorate the first English settlement, which is to open April 26th, 1907, the Department of Public Instruction proposes to make a Comparative Educational Exhibit, using some of the work from all of the expositions in which New Jersey has been represented. We think New Jersey is the only State that can make such an exhibit, as she alone has preserved her educational material. The exhibit will show the advancement New Jersey has made in her educational advancement in the past thirty-one years.

GEOLOGICAL SURVEY.

The geological specimens of the Museum, collected by the State Geological Survey, were not materially increased during the year. Under the direction of the State Geologist much has been accomplished toward making the material more accessible for reference. The minerals and rocks have been numbered, and the labels entered in a permanent accession book. Index cards have also been prepared for many specimens. Some progress has been made with the work on paleontological material, but it will be some time before all the collections are properly classified. When the work is completed there will be a list of all specimens arranged numerically in a book, and a card-index arranged by subjects and localities. A permanent label-number in paint has been placed on each specimen so there is no chance of the specimens becoming valueless if the label should be lost.

Three new cases were received during the year, thus replacing the older ones which have been in use since 1876. These were discarded by the necessity for more storage-room, which they did not furnish. This change of cases gave an opportunity to

change the material on exhibition, and in some instances to substitute more desirable specimens. Numerous small colored maps of the State, showing the location of the material on exhibition, have been placed in each case. The display of clay, which received the Gold Medal at the St. Louis Exposition, has been installed. A series of specimens designed to illustrate the processes of separating and concentrating the zinc ore, mined at Franklin Furnace, has been arranged. A similar set of specimens shows the successive steps in the magnetic separation of the iron ores.

A number of cretaceous fossils were withdrawn from exhibition for preparation and study, but with the completion of the report upon these forms, which is in preparation under the direction of the State Geologist, these specimens and many others will be available for the Museum.

OBJECT OF THE MUSEUM.

The Commission of the State Museum is trying to make it one of the factors in the line of education, and are in hope at no distant date to see the teachers and others of the State bring their pupils and friends to it for study as well as pleasure.

At the present time many students are availing themselves of the opportunity of visiting the Museum to study its many specimens. This is especially the case with the students of the State schools, the schools in and near Trenton, and some from Pennsylvania. We feel that it would be very profitable if excursions for the children and teachers could be taken to the State House to visit and study the Museum with its many educational advantages. No doubt arrangements can be made with the railroads and trolleys for reasonable terms. Besides the Museum there are many other things of interest to be seen, not only in the State House and other State institutions in the city of Trenton, but many historical and local features of interest.

The number of visitors has greatly increased during the last year. From the number that have registered during the time we have had our register opened, it is estimated that more than

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15,000 have visited the Museum in the past year. The number is continually increasing, and when it becomes known that we have so much that is interesting and attractive, the number of visitors will probably increase. There are comparatively few persons, even in New Jersey, that know what a fine museum the State possesses, as we have not tried to advertise it.

WANTS OF THE MUSEUM.

We are greatly in need of more room. Every part of the space in the present museum rooms is occupied, and many of the cases are crowded with specimens.

In order to build the new addition to the State House it was necessary to demolish the building where the new addition was to be erected. In the third story of this old part of the State House was one of the rooms in which we had a part of our educational exhibit. We were, of course, obliged to remove it. The only place we had for storage was in the other room containing educational exhibits. By this method it filled the room so full that we were obliged to close it, thus locking up nearly all of the educational exhibits. As the rooms in the new building are for other purposes, we shall have no room for this material. There should surely be some provision made for them.

As the new Museum hall, finished in 1902, is full, we have many specimens that cannot be placed on exhibition, and are continually receiving new specimens, more room should be provided for them. The Museum Commission urgently recommend that more room be at once furnished them for the Museum. The Geological Survey are now obliged to rent room outside for their chemical laboratory. There should be room for this in or near the Museum. This we cannot too strongly urge—the necessity for more space.

We have added for the Geological Department three new combination cabinets with storage space under the show cases, which are a great improvement over the old ones. We are in need of at least two more of the same kind.

We also need more cabinets for the other departments, but we have no room to place them. The State House Commission has never furnished any cabinets or other furniture for the Museum since its establishment, but nearly all of it has been received from the expositions—that is cabinets and other furniture used at these expositions have been utilized, thus saving many thousands of dollars to the State. Nearly all of our furniture is good and modern.

CARD SYSTEM.

During the year we have had a complete card system made of all the specimens in the several exhibits. This makes it an easy matter to locate any specimen one may wish to find. It has taken much careful study and work, but will enable great saving of time and labor.

We have adopted for the birds, eggs and nests the numbers used by the American Ornithologists' Union, and numbered them accordingly.

NEW COLLECTIONS.

Until the State Museum was established, only a few years ago, there was no place in the State where natural history and other specimens could be placed and exhibited, therefore many very valuable specimens left the State and found homes in other places.

It is the desire of the Museum Commissioners to make the New Jersey State Museum truly a New Jersey State Museum, where in the future our citizens may have a place to deposit such specimens as may be of interest to our people.

The Commissioners are anxious to receive such, and extend an invitation to all who can to make such donations to the Museum, and due credit will be given for the same to each contributor. Any person having specimens is invited to correspond with the Curator of the Museum on the subject. Those making donations will be entitled to receive a copy of the annual report and other printed matter issued by the Museum.

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SPECIMENS OF BIRDS PROCURED DURING THE YEAR.

- 1 white pelican.
- 1 peacock (male).
- 1 ring-billed gull.
- 1 black skimmer.
- 1 crested grebe.
- 1 least bittern.
- 1 winter grosbeak.
- 1 king rail (young).
- 1 clapper rail (young):
- 1 chimney swift.
- 1 house wren.
- 1 great crested fly-catcher.
- 2 ravens (male and female).
- 2 pied-billed grebes (male and female).

SPECIMENS OF FISH (MOUNTED).

- 1 weak fish.
- 1 croaker.
- 1 fluke.
- 1 angel-fish.

Collection of brook-trout eggs (25 bottles or specimens), showing the advancement of incubation until they are hatched. This set was prepared for the Museum by the United States Fish Commission, at its fish hatchery in Leadville, Colorado, by Superintendent W. T. Thompson, and presented to the New Jersey State Museum.

A collection of shad eggs (27 bottles or specimens), showing the advancement of incubation. This was also prepared by the United States Fish Commission, at Havre de Grace, Maryland, under the supervision of J. J. Glennan. They were presented to the State Museum by the United States Fish Commission.

BIRDS, EGGS AND NESTS IN ORIGINAL SETS FROM ERNEST H. SHORT.

Eggs.

- 3 Caspian tern.
- 8 blue-winged teal.
- 3 Canada goose.
- 4 Louisiana heron.
- 4 little blue heron.
- 4 green heron.
- 4 black-crowned night heron.
- 6 king rail.
- 7 Virginia rail.
- 4 spotted sandpiper.

- 4 killdeer plover.
- 3 Wilson's plover.
- 3 oyster-catcher.
- 3 black-billed cuckoo.
- 7 flicker.
- 2 whip-poor-will.
- 2 night hawk.
- 5 scissor-tailed fly-catcher.
- 5 crester fly-catcher.
- 4 Phoebe.
- 5 American crow.
- 4 red-winged blackbird.
- 3 lark sparrow.
- 4 summer tanager.
- 5 purple martin.
- 4 roughed-winged swallow.
- 4 oven-bird.
- 3 Maryland yellow-throat.
- 4 Yellow-breasted chat.
- 7 long-billed marsh wren.
- 3 russet-back thrush.
- 4 American robin.
- 4 American robin.
- 2 parasitic jaeger.
- 1 sooty tern.
- 1 stormy petrel.
- 3 double-crested cormorant.
- 3 white ibis.
- 5 least bittern.
- 7 American barn owl.
- 5 American long-eared owl.
- 5 purple martin.
- 4 mockingbird.
- 4 catbird.
- 6 house wren.
- 4 northern downy woodpecker.
- 5 red-headed woodpecker.
- 5 tree swallow.
- 3 least tern.
- 3 kittiwake gull.
- 1 gannet.
- 2 red-throated loon.
- 4 meadow lark.
- 5 cliff swallow.
- 4 kingbird.

Nests.

- 3 and nest white-eyed vireo.
- 4 " " yellow warbler.
- 4 " " magnolia warbler.

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- 4 and nest chipping sparrow.
- 5 " " Baltimore oriole.
- 5 " " American redstart.
- 4 " " hooded warbler.
- 3 " " prairie horned lark.
- 3 " " red-eyed vireo.
- 1 " " black-throated green warbler.
- 1 nest of black-crowned night heron.
- 1 " " laughing gull.
- 1 " " red-shouldered hawk.
- 1 " " red-tailed hawk.

Mounted Birds.

Solitary sandpiper.
Hooded warbler.
Blackburnian warbler.
Loon.
Dovekie.
Black-necked stilt.
Black-necked stilt.
Long-billed curlew.
American sparrow hawk.
Redpoll.

SPECIMENS OF MAMMALS.

- 1 mounted beaver, also showing tree stump cut down by the beaver.
This shows how they work.
- 1 moose head.
- 1 caribou head.
- 1 deer head (female).
- 1 ground-hog or wood-chuck.
- 2 flying squirrels.
- 4 red squirrels (young).
- 1 white ferret.
- 1 dark ferret.

PUBLICATIONS RECEIVED DURING THE YEAR.

Annual Report of the Smithsonian Institution for 1904.
Annual Report of the Smithsonian Institution for 1905 and 1906. National Museum.
Annual Report of the Department of the Interior, 1904. Vols. 1 and 2. Commissioner of Education.
Reports of the New Jersey Agricultural Experimental Station.
The Woodsman's Handbook.

State of New York.

Report of the Forest, Fish and Game Commission, 8th and 9th report, 1902-1903.

Report of the Injurious and other Insects of the State of New York.

New York Aquatic Insects in New York. University of N. Y., 1903.

Bulletin of the New York Botanical Garden. December 18, 1906.

Bulletin of the New York Botanical Garden. February 13, 1906.

Report on the Turtles and Lizards Found in the Vicinity of New York City.

Report on the Fishes of the Fresh and Brackish Waters in the Vicinity of New York City.

A Catalogue of the Fishes of Bermuda, with notes on a collection made in 1905 for the Field Museum, by Tarleton Bean.

Report of the New York State Museum, 1905.

Several Reports from the Different Departments of the State.

BOOKS PURCHASED.

The Naturalist Library, 10 volumes.

North American Birds' Eggs, by Charles K. Reed.

Color Key to North American Birds, by Charles K. Reed.

Bird Guide, Part I—Water Birds East of the Rockies, by Charles K. Reed.

Bird Guide, Part II—Land Birds East of the Rockies, by Charles K. Reed.

The Birds of Eastern Pennsylvania and New Jersey, by Witmer Stone. (Two copies.)

Financial Report.

| | | |
|---------------------------------------------------------|------------------------------------------------------------|------------|
| 1905. | | |
| Oct. 31. | Stenographer's services in Museum, | \$320 00 |
| | George Pine, services in Museum, | 240 00 |
| 1905. | | |
| Nov. 14. | Adams Express Co., express charges to October 20, 1905, | 19 75 |
| 1906. | | |
| Feb. 13. | August Hammer, glass, etc., furnished December 4, 1905, | 9 15 |
| April 3. | W. F. Yard, for trays for Museum, March 6, 1906, | 9 00 |
| | F. H. Lattin, skin of Peacock furnished Mar. 3, 1906, | 5 00 |
| 10. | U. S. Express Co., express charges from October 6, 1905, | |
| | to March 27, 1906, | 6 13 |
| 27. | Frank Blake Webster Co., mounted specimens furnished | |
| | March 26, 1906, | 31 20 |
| May 15. | W. F. Yard, for trays furnished Geological Department | |
| | April 30, 1906, | 5 00 |
| 22. | S. L. Crosby Co., mounting fish, April 12, 1906, | 29 60 |
| | Ernest H. Short, mounted specimens and eggs, May 14, | |
| | 1906, | 34 87 |
| | D. M. Heywood, mounted beaver furnished March 2, | |
| | 1906, | 25 00 |
| June 5. | Adams Express Co., to March 27, 1906, | 12 85 |
| July 10. | New Jersey School, Church Furniture Co., for furnishing | |
| | cases, etc., | 336 00 |
| 17. | Eimer & Amend, glass jars furnished June 28, 1906, | 8 64 |
| 31. | M. Abbott Frazar Co., for mounted moose, caribou and | |
| | doe's head, July 11, 1906, | 85 00 |
| Aug. 28. | Chas. K. Reed, for books furnished May 4, 1906, | 9 00 |
| Oct. 4. | Petry's Express, for freight and carting, | 8 67 |
| | Adams Express Co., for express charges, | 12 85 |
| | United States Express, for express charges, | 13 32 |
| | MacCrellish & Quigley, for stationery, | 7 75 |
| | Henry W. Fowler, for preparing the "Fishes of N. J.," .. | 100 00 |
| | W. F. Yard, paper boxes for Geological Department, ... | 20 00 |
| | Jacob C. Cassel, for globes, stands, etc., | 28 89 |
| | Wm. H. Werner, for specimens, | 50 25 |
| | United States Express Co., for express charges from | |
| | October 12 to 21, 1906, | 24 81 |
| | S. R. Morse, expenses to October 29, 1906, | 30 01 |
| | Postage to October 29, 1906, | 38 43 |
| | | <hr/> |
| | | \$1,521 17 |
| To this should be added the bill of the Library Bureau, | | |
| which was included in our last year's report, but not | | |
| paid till this year by the State Treasurer, | | \$78 83 |
| | | <hr/> |
| | | \$1,600 00 |

PART II.

THE AMPHIBIANS AND REPTILES
OF NEW JERSEY.

By HENRY W. FOWLER,

Of the Academy of Natural Sciences of Philadelphia.

PREFACE.

Like the "Fishes of New Jersey," published in last year's report of this Journal, the present work similarly deals with the amphibians and reptiles known from within the present limits of the state of New Jersey. Although I have no new additions to the fauna in this department, much yet remains to be studied concerning most of the species. But few have in any way been examined with more than even a partial glimpse at their life histories within the large district embraced in the state's boundaries. Therefore, when the necessary exploration has been conducted, comparison with other localities may aid in clearing the way of some of our present stumbling-blocks. However, the purpose of this work, like that of last year's, is not so much an attempt at further elucidation as an exposition of what is now known of the subject from my own observations. As with the fish-fauna, some records of rare or unusual species have been added recently. In several cases species have been described from within our limits, and these are all in need of examination and elaboration. I have been fortunate in most of these instances to be able to present further information, together with verifications, etc., which it is trusted will conduce to place the subject in compact form for future workers.

I have followed the classification used by Dr. David Starr Jordan, in his Manual of the Vertebrate Animals of the Northern United States, as the most satisfactory. It is based largely on Cope's different articles. I have only listed the generic names, and where the few changes are made they will be noted under their respective species. Keys are given, based largely on Dr. Jordan's. I have based the description of each species on a New Jersey example, wherever possible to secure one, and in the cases of those where less fortunate give a short diagnosis,

with remarks. The vernaculars are compiled from different writers who have written on New Jersey amphibians and reptiles, together with such as I could gather myself. Nearly complete references to each species, as credited from within our limits, are given, as far as I could find up to the present time. Of course the general nature of some of the works will indicate the distribution of a species without mentioning that it has ever occurred in New Jersey. In several of these cases it is probable that the author's studies were at least based in part on New Jersey material, aside from what may be mentioned. From the fact that great activity in zoölogy centered about Philadelphia formerly, it may be naturally inferred that the animals then studied were largely known from the environs of the home locality. This is especially the case with Harlan and others.

I am under great obligations to the Academy of Natural Sciences of Philadelphia for the use of its library and unexcelled collection of New Jersey amphibians and reptiles. In the laboratory of that institution all of the species represented by specimens were drafted, besides affording additional advantages for comparison with the fine series of specimens from other localities. The collections of this institution embrace possibly some of the most interesting amphibians and reptiles extant. Most of the original types described by Jacob Green are still in good condition, and some have been included in this report. Samuel Ashmead made collections at Beesley's Point, most of which were studied by the earlier naturalists. Dr. Charles C. Abbott made very important collections about Trenton. Prof. Edward D. Cope also made several collections at different places. Mr. Samuel N. Rhoads made fine collections, principally in the northern part of the state. Mr. Witmer Stone, together with Messrs. J. A. G. Rehn, H. L. Coggins and others, made various trips to the pine-barren and southern regions with success. Finally, the writer, during his various fishing excursions, visited many localities as already enumerated last year, together with many others, and has thus been enabled to gather a lot of information. Many notes were made in the field which are included in this work, especially those with reference to fresh or living examples.

I am indebted to the State Museum of New Jersey and its able Curator, Mr. Silas R. Morse, for assistance in facilitating the work of this report. To Dr. Charles C. Abbott, of Trenton, for some information and assistance. To Prof. Ulric Dahlgren, of Princeton University, for information on the salamanders about Princeton. To Mr. Witmer Stone, for materials and notes on examples from various localities. To Mr. Wm. J. Fox, who has added much to the ichthyology of Sea Isle City, for notes principally concerning the marine reptiles of that region. To Mr. Thomas D. Keim, for much information and assistance when in the field during our many pleasant trips. To Mr. H. Walker Hand, of Cape May, for information and assistance while working in that region. To Mr. David McCadden, Mr. J. A. G. Rehn, Mr. Bartram W. Griffiths, Mr. Chreswell J. Hunt, Mr. S. Harbert Hamilton and Mr. George Z. Hartman, of Palermo, in Cape May County, and many others, for information or assistance in collecting specimens.

The figures given in this report are mainly taken from those in the second edition of Holbrook's North American Herpetology. Several have been taken from other accessible works, or drawings of my own. The text figures are from Cope's works on North American amphibians and reptiles.

Finally, I shall state that though errors may occur in this work, no excuse is made in their behalf, and it is trusted that they are few and far. It is with the hope that it will be of use and value to those who are interested in the subject, and furnish an impulse to a new and more complete account in the near future.

HENRY W. FOWLER,
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NOVEMBER 17TH, 1906.

The Amphibians and Reptiles of New Jersey.

BY HENRY W. FOWLER.

INTRODUCTION.

In the "Fishes of New Jersey" I have already called attention to some salient ichthyographic features of the state, which, to little extent, have bearing on the distribution of the amphibia and reptilia. As opposed to that of fishes the marine fauna is the poorest, while the upland and fresh waters contain the richest. As amphibia and reptilia are more or less restricted at all times in their distribution, it is natural that there should be little if any difference in the presence of species, either in cold or warm weather. This, of course, is due to their higher organization than fishes, and especially to the fact that they are air breathing. The pelagic forms, if the widely roving sea-turtles may be so termed, are represented only by several species. The fauna of the salt-marsh is also very poor, and is properly represented by but a single terrapin. In the fresh marshes it is very different, as there reptiles occur in abundance, and so on over both dry land and inland fresh waters to the very hill-tops. Not all of these animals are necessarily aquatic, though most are largely so. A noticeable feature of the distribution of the upland fauna in its costal range is seen along the edge of the Cape May County salt-marsh. Several upland species occur there which do not seem to be back in the intervening cedar-swamp country. However, the writer has as yet had neither the opportunity or data to throw much light on this interesting question of local distribution. One thing very apparent to most anyone who studies the amphibians and reptiles of the state is the great variation in color which most species will show. No clear

explanation seems to be possible to me for some of the cases met with, as they will often all occur under the same conditions. Possibly during my extended local work in ichthyology I may be able to find opportunity to offer more important data. As should have been stated before, most all of the information which I have gathered in the direction of this work was made during the numerous fishing excursions into different parts of the state. I have, however, at different times made some interesting observations, and hope in the future to make others. The conclusion of this report will then place what I have been able to gather of the living cold-blooded vertebrate fauna of New Jersey.

FAUNAL WORKS.

Though the earlier works on herpetology, such as those of Beauvois, Green, Harlan and Holbrook, frequently contain accounts of New Jersey amphibians and reptiles, their more general nature forbids their consideration as restricted to the State. I have, however, located all the New Jersey references under each species where found. Most of the early papers of Cope and others are also of more or less similar nature, and have been treated in the same way.

CHARLES CONRAD ABBOTT.

1869. Catalogues of Vertebrate Animals of New Jersey. <Geology of New Jersey, 1868. Appendix. Reptiles and Amphibians, pp. 799-805.

This is the first attempt to give an annotated account of the amphibians and reptiles of the state. Like the other departments embraced, it is only a list of the species, with notes on their abundance and habits, etc., which, in most cases, were based on the author's own observations. The identifications were given largely by Cope. The work is also attended with the unfortunate uncorrected proof, as in the case of the fishes.

1882. Notes on the habits of the "Savannah Cricket Frog." <American Naturalist, XVI, 1882 (September), pp. 707-711.

1884. Recent studies of the Spade-foot Toad. <L. c., XVIII, 1884 (November), pp. 1075 to 1080, figs. 3.

A good account of the development of this interesting animal.

1885. A Naturalist's Rambles about Home. New York. D. Appleton & Company, 1, 3 and 5 Bond street.

This contains a popular account of the amphibians and reptiles as observed mostly near Trenton, see chapters 29-33, pp. 250-350. In the appendix is a list of the amphibians and reptiles of Mercer County, pp. 475-477.

1889. The Pine-tree Lizard. <Pop. Sci. Month., XXXIV, 1889, pp. 162-171, with several figures.

A complete account of some observations on *Sceloporus undulatus*, with some notes on *Eumeces fasciatus*.

1890. Voice of *Hyla andersonii*. <American Naturalist, XXIV, 1890 (February), p. 189.

SAMUEL LOCKWOOD.

1875. The Pine Snake of New Jersey. <American Naturalist, IX, 1875 (January), pp. 1-14.

— Some Habits of the Pine Snake. <L. c. (July), pp. 424-425.

1880. The Pine Snake. <L. c., XIV, 1880 (July), p. 528.

T. M. BRYAN.

1879. Large Rattlesnakes. <American Naturalist, XIII, 1879 (October), p. 322.

Note on the occurrence of rattlesnakes near Vincentown.

JOHN FORD.

1879. The Leather Turtle. <American Naturalist, XIII, 1879 (October), pp. 633-637.

A complete account of this animal from our shores, with remarks.

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JOHN E. PETERS.

1889. Another specimen of *Hyla andersonii*. <American Naturalist, XXIII, 1889 (January), p. 58.

Records an example from near May's Landing.

JULIUS NELSON.

1890. Descriptive Catalogue of the Vertebrates of New Jersey. <Rep. Geol. Surv., II, pt. 2, Min. Bot. Zool., 1890, pp. 1-824, Amphibians and Reptiles, pp. 637-657.

A compiled descriptive account of each species, mostly from Dr. Jordan's "Manual of the Vertebrate Animals of the Northern United States," without reference to definite material, and based on quoted notes from Dr. Abbott's work of 1869.

EDWARD DRINKER COPE.

1896. A New Species of Frog from New Jersey. <American Naturalist, XXV, 1891 (November), pp. 1017-1019.

Rana virgatipes described as new, and remarks are made on some of the interesting amphibians and fishes of the region.

1894. Trionyches in the Delaware drainage. <American Naturalist, XXVIII, 1894 (October), p. 889.

Note on the above. Records examples of the "soft-shelled turtle" from near Woodbury.

J. PERCY MOORE.

1893. The Eggs of *Pityophis melanoleucus*. <American Naturalist, XXVII, 1893 (October), pp. 878-885, figs. 9-10, Pls. 19 to 20.

1894. Note on the Occurrence of *Hyla andersonii* in New Jersey. <L. c., XXVIII, 1894 (December), pp. 1045-1046.

1896. *Lygosoma (Liolepisma) Laterale* in New Jersey. <L. c., XXX, 1896 (September), pp. 752-753.

CHARLES W. JOHNSON.

1894. Trionyches in the Delaware drainage. (American Naturalist, XXVIII, 1894 (October), p. 889.

An account of the "soft-shelled turtle" taken at Paulins Kill, at Hainesburg, Warren County.

WILLIAM L. SHERWOOD.

1895. The Salamanders Found in the Vicinity of New York City, with Notes upon Extra Limal or Allied Species. <Abstract of Proc. Linn. Soc. N. Y., 1894-95, No. 7, pp. 21-41.

This treats of the salamanders of the northeastern part of the state.

1898. The Frogs and Toads found in the Vicinity of New York City. <L. c., 1897-98, No. 10, pp. 9-27.

R. L. DITMARS.

1896. The Snakes Found within Fifty Miles of New York City. <Abstract of Proc. Linn. Soc. N. Y., 1895-96, No. 8, pp. 9-27.

EUGENE SMITH.

1899. The Turtles and Lizards Found in the Vicinity of New York City. <Abstract of Proc. Linn. Soc. N. Y., 1898-99, No. 11, pp. 11-36.

WITMER STONE.

1901. Occurrence of Hyla andersonii at Clementon, N. J. <Proc. Acad. Nat. Sci. Phila., 1901 (June), p. 342.

This note sums up the records of the occurrence of this interesting species, and gives an additional one for Clementon, based on an example collected by Mr. H. L. Viereck, May 12th, 1901.

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1906. Notes on Reptiles and Batrachians of Pennsylvania, New Jersey and Delaware. <American Naturalist, XL, 1906 (March), pp. 159-170.

A list, with notes, on amphibia and reptilia from the states mentioned above, and giving the writer's examination of New Jersey material based on his own observations and the examples contained in the collection of the Academy of Natural Sciences of Philadelphia. This valuable paper contains a number of interesting records and a verification of previous ones.

WILLIAM T. DAVIS.

1904. *Hyla andersonii* and *Rana virgatipes* at Lakehurst, New Jersey. <American Naturalist, XXXVIII, 1904 (October), p. 893.

1905. Further Note on *Hyla andersonii* and *Rana virgatipes* in New Jersey. <L. c., XXXIX, 1905 (November), pp. 795-796.

In this account *Hyla andersonii* is said to be abundant at Lakehurst.

1906. Additional Observations on *Hyla andersonii* and *Rana virgatipes* in New Jersey. <L. c., XLI, 1906 (January), pp. 49-51.

HENRY W. FOWLER.

1905. The Sphagnum Frog of New Jersey—*Rana virgatipes* Cope. <Proc. Acad. Nat. Sci. Phila., 1905 (September) [issued November 2nd], pp. 662-664, Pl. 40.

1906. Note on Muhlenberg's Turtle. <American Naturalist, XL, 1906 (August), p. 596.

Class Amphibia.**The Amphibians.**

Coracoid element of scapular arch distinct and with quadrate bone. Limbs consist of a single proximal element, 2 propodials (sometimes united), a carpus and tarsus, metapodials and phalanges. Cartilage of basis-cranii unossified usually, and supported by parasphenoid. Vertebral column consisting entirely or in part of intercentra. Stapes present. Cerebellum small. Mesencephalon smaller than prosencephalon or hemispheres, and latter with ventricles on inner side of their principal mass. Heart with 3 chambers, 2 auricles and a ventricle. On each side of heart 3 or 4 aorta bows. Lungs always present. Gall-bladder and urinary-bladder present. Oviducts entirely distinct, and opening by fontanels into abdominal cavity at a distance from ovaries. Reproductive, renal and digestive products discharged into a cloaca. Male without distinct intromittant organ.

Cold-blooded vertebrates, intermediate between fishes and reptiles. They differ from fishes chiefly in the absence of rayed fins, the limbs being usually developed and functional with the skeletal elements of the limbs of reptiles, and in the reduction or absence of the various bones of the branchial, opercular and suspensory systems. Amphibians have a more or less complete metamorphosis. The young, or tadpoles, are fish-like, more or less aquatic, and breathing by means of external gills. These differ from the gills of fishes in standing on fleshy processes of the branchial bones, and not on the bones themselves. The tadpole's tail is provided with a more or less distinct fin-like membrane, usually disappearing with age. Later lungs develop, and in most cases the gills disappear. Skin mostly naked and moist, used to some extent as an organ of respiration. Reproduction by means of eggs, which are of comparative small size and without hard shell. They are deposited in or about the water. Rarely are the young born alive.

Key to the orders.

- a. Body elongate, with tail always distinct; hind limbs not especially enlarged. URODELA
aa. Body short, depressed; tail disappearing with age; hind limbs much enlarged. SALIENTIA

Order URODELA.

The Salamanders.

Body naked, subterete. Our forms always with 4 limbs. Tail persistent. Both jaws with teeth. No external gills in normal adult. Eggs laid in water or on land, in former case attached singly or in small numbers to leaves of aquatic plants, and in latter case in little concavities beneath stones or bark.

The salamanders reach their greatest development in the temperate regions of the New World, and are probably of considerable antiquity.

Key to the families.

- a. TREMATODERA. Side of neck with a spiracle or rounded opening; no eyelids; teeth on front or outer edges of palatines. CRYPTOBRANCHIDÆ
- aa. PSEUDOSAURIA. Side of neck without spiracle; eyelids present; teeth on posterior or inner edges of palatines.
 - b. Series of palatine teeth in transverse or posteriorly converging series, inserted on posterior portion of vomer.
 - c. Vertebræ amphicælian, or double-concave.
 - d. Parasphenoid, behind vomer, without teeth; tongue large, thick, with radiating folds, its margin little free; carpus and tarsus ossified. AMBYSTOMATIDÆ
 - dd. Parasphenoid with teeth; tongue small, largely free; carpus and tarsus cartilaginous. PLETHODONTIDÆ
 - cc. Vertebræ opisthocælian, or concave behind only. DESMOGNATHIDÆ
 - bb. Series of palatine teeth 2 longitudinally, diverging behind, and inserted on inner margin of 2 palatine processes. PLEURODELIDÆ

Family CRYPTOBRANCHIDÆ.

The Giant Salamanders.

Body robust. Limbs well developed. An orifice on each side of neck usually persistent throughout life. Tongue covering floor of mouth. Vomerine teeth on anterior border, very strong. Nostrils very small. No external gills. Toes 4-5. Vertebræ amphicæulous, without anterior double hypophysis. Tail developed. Parietal and prefrontal bones embracing frontals and meeting above orbits. Vestibule with internal wall membranous. No ethmoid bone. Pterygoid bone present. Carpus and tarsus cartilaginous.

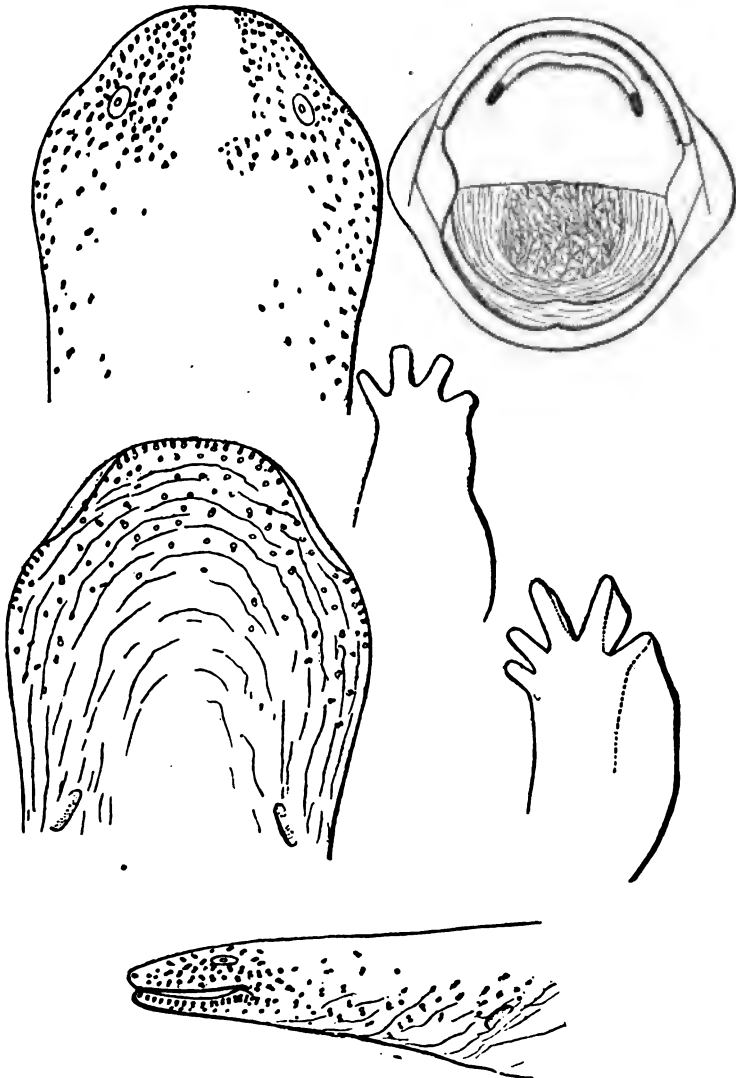
Largest of the salamanders, found in eastern Asia and the United States.

Genus *CRYPTOBRANCHUS* Leuckart.

The Hellbenders.

Cryptobranchus alleganiensis (Daudin).

PLATE I.



Hellbender. *Cryptobranchus alleganiensis* (Daudin).

Hellbender.

This is the largest of our salamanders, reaching a couple of feet in length. It may be known by the fold of skin extending along the side of the body and its blackish color. Though very unprepossessing, it is harmless.

This is only known to me from within the limits of the state by the record of Dr. C. C. Abbott. It may have escaped from aquaria, as about 1860 quite an interest was taken in aquatic life in Philadelphia. Many animals were brought from distant localities, and in some instances were freed in the Delaware valley. Its admittance to our fauna is, therefore, questionable. The specific name as spelled above is exactly like that employed by Daudin.

Menopoma alleghaniensis Abbott, Nat. Rambles, 1885, p. 477.

Family AMBYSTOMATIDÆ.

The Blunt Nosed Salamanders.

Tongue thick. No ethmoid. Palatine bones not prolonged over parasphenoids, bearing teeth on their posterior margins. Orbitosphenoid separated from proötic by membranous walls. Internal wall of vestibule osseous. Vertebræ amphicoelous. Pre-frontals and pterygoids present. Premaxillaries fully developed. Parasphenoid without dentigerous plates. An otoglossal cartilage, only 1 first epibranchial, and second basibranchial isolated. Carpus and tarsus ossified. Toes 4-5, not webbed.

Mostly with species of large size from North America, and possibly one from Siam. They are of particular interest among the *Urodela* as furnishing connecting forms between the ordinary types of the order and those larger species supposed to be more characteristic of former periods of the earth's history. The single genus *Ambystoma*, represented by several species, within our limits.

Genus AMBYSTOMA Tschudi.

The Blunt Nosed Salamanders.

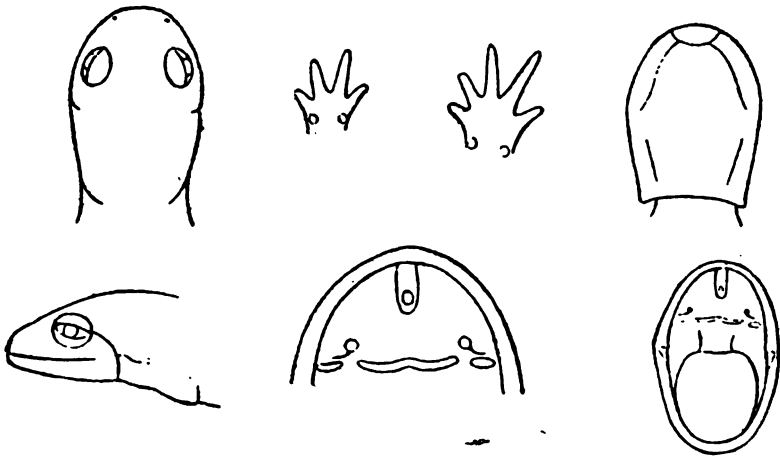
Key to the species.

- a. Costal grooves usually 11.
- b. Body with gray cross-shades.
- bb. Body spotted, mostly with yellowish.

- c. Sole with a single distinct tubercle.
 - d. A dorsal groove; blackish above, with a series of yellow spots on each side. PUNCTATUM
 - dd. No dorsal groove; lead-colored with inferior or lateral series, and usually a superior series of small irregular yellowish-gray spots. CONSPERSUM
- cc. Sole with 2 distinct tubercles; dark bar on side of neck. BICOLOR
- aa. Costal grooves usually 12.
 - e. Sole with 2 distinct tubercles; brown, with yellow spots varying. TIGRINUM
 - ee. One or no tubercles on sole; leaden to brown, and pale spotted or not laterally. JEFFERSONIANUM

Ambystoma opacum (Gravenhorst).

PLATE 2.



Blotched Salamander. *Ambystoma opacum* (Gravenhorst).

Blotched Salamander. Marbled Salamander.

Head $5\frac{1}{2}$; depth $9\frac{1}{3}$; width of head $1\frac{2}{3}$ in its length from snout to gular fold; length of mouth, or gape, $1\frac{7}{8}$; interorbital space, measured from eye-sockets, $3\frac{2}{3}$; width of mouth $1\frac{2}{3}$; snout $3\frac{1}{8}$; fore limb about 1; hind limb $5\frac{2}{3}$ in total length of body; tail $1\frac{3}{5}$ in rest of body. Body thick, cylindrical, with swollen appearance. Surface all rounded, smooth and convex. Trunk nearly cylindrical, though with depressed appearance. No dorsal furrow. Costal grooves 11, including inguinal. Pelvic

grooves obsolete. Grooves on tail rather obsolete, mostly noticeable below anteriorly, and others fading out behind. Tail thick, somewhat oval in cross-section with bulge above, surface smooth, convex and without any indication of keel. Base of tail nearly cylindrical, though lower surface becoming compressed towards tip, which is pointed. Lateral groove on tail obsolete. Head broad, flattened or depressed below, and convex above. Profile rather obtuse in front. Snout twice as broad as long, projecting a little beyond mandible, and broadly convex when viewed above. Eye a little elongate, or ellipsoid, of moderate size, elevated, and placed near first $\frac{3}{5}$ in length of head. Eyelids fleshy and well developed. Pupil circular. Mouth broad, its profile when viewed from below similar to that of snout as seen from above. Lips rather firm, little developed. A slight vertical constriction behind angle of mouth made up of 2 vertical grooves, first close to rictus and second or posterior just in front of shoulder, and these united by a connecting horizontal groove on side. Teeth minute, uni-serial and numerous along edges of jaws. Teeth on roof of mouth forming 3 patches transversely of a single series each, median much larger than each small lateral patch, which is separated from either end by a decided interval, and somewhat double-lunate in shape, with convexities facing down throat. Lateral patch about $\frac{1}{4}$ length of median. Tongue large, broadly ellipsoid, fleshy, largely filling mouth, and surface finely plicated. Interior nares just before each lateral patch of teeth on roof of mouth. Exterior nostrils near front edge of snout, inconspicuous, rather small, and space between about equal to bony inter-orbital space. Both interorbital and internasal regions rather evenly though slightly convex. Skin perfectly smooth, under a lens showing minute simple pores everywhere, except to some extent on lower surface. These pits or pores apparently connected with glands. No regular patches of more conspicuous ones on head and parotids. Fore limb inserted at first fifth of body, and reaches $\frac{4}{7}$ of space to hind limb. Digits linear, rather elongately conical, depressed basally, and without web or margin. Third finger longest, 3 in rest of arm, first and fourth shortest and subequal. Hind limb inserted a little nearer tip of snout than tip of tail, and reaching $\frac{3}{5}$ to latter. Fourth toe longest, about

2½ in rest of leg, first shortest, and fifth a trifle shorter than second. Soles of each foot with 2 small tubercles. Vent large, longitudinal, just after hind legs on lower surface of trunk. Color in alcohol faded muddy-brownish generally. An obsolete dorsal series of transverse slightly paler or grayish ill-defined bands, and on upper surface of tail broader and tinted ochraceous. These blotches about 10 on head and trunk and 8 on tail. They do not descend on lower or under surface of body. A similar patch on snout. Iris brownish. Length 3 18/16 inches. Cotype of *Salamandra fasciata* Green. New Jersey [probably near Princeton?]. Prof. Jacob Green.

The 4 other cotypes, with same data, also examined. One has a double or forked tail for half the length of the series of caudal vertebræ, and all the individuals are shorter in length than that described. Other examples which I have examined were taken at Hammonton (Charles Liebeck), Medford (J. S. Wills), and Beesley's Point (Samuel Ashmead). They vary considerably in color, the Hammonton example being more narrowly and evenly striped than the others. The general color of its body is a livid slaty-dusky with the pale transverse streaks pale plumbeous-gray on the trunk, and becoming more or less brownish. It is also the largest example, measuring 4 7/16 inches. The example collected by Mr. Wm. J. Fox, and reported from Atlantic City by Mr. Witmer Stone, came from Dacosta in Atlantic County. The eggs are said to be laid in the water and hatch in late April or early May. The young develop rapidly, though the larvæ may be found as late as the early summer. The young are dotted or spotted with white. When about 2 inches long they begin to show the usual coloration. When adult they are said to burrow in dry places, as about stones in gravelly or sandy soil. They appear to hibernate late in the fall. Dr. Abbott tells me he found an example near Trenton, but believes it to be uncommon. Prof. Dahlgren found it in a stream near Princeton.

Ambystoma opacum Hallowell, Journ. Acad. Nat. Sci. Phila., (2) III, 1855-58 (January, 1858), p. 351.

Amblystoma opacum Abbott, Geol. N. J., 1868, p. 804.—Cope, Bull. U. S. Nat. Mus., No. 34, 1889, p. 54, Pls. 19-21.—Sher-

wood, Proc. Linn. Soc. N. Y., 1894-95, No. 7, p. 27.—Stone, Am. Nat., XI, 1906, p. 160.

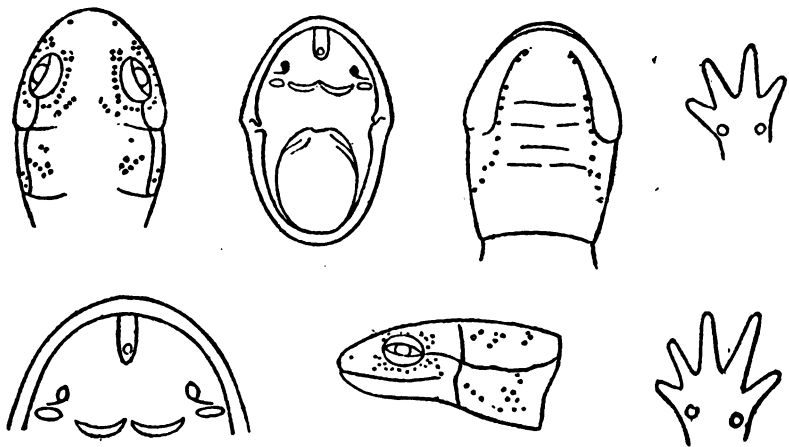
Salamandra fasciata Green, Journ. Acad. Nat. Sci. Phila., I, pt. 2, 1818, p. 350.—Harlan, Journ. Acad. Nat. Sci. Phila., V, pt. 2, 1827, p. 329.—Harlan, Med. Phys. Res., 1835, p. 95 (copied).—Holbrook, N. Am. Herp., III, 1838, p. 103, Pl. 25 (from Green).—Hobrook, l. c., Ed. 2, V, 1842, p. 71, Pl. 23.

***Ambystoma punctatum* (Linnæus).**

PLATE 3.

Spotted Salamander.

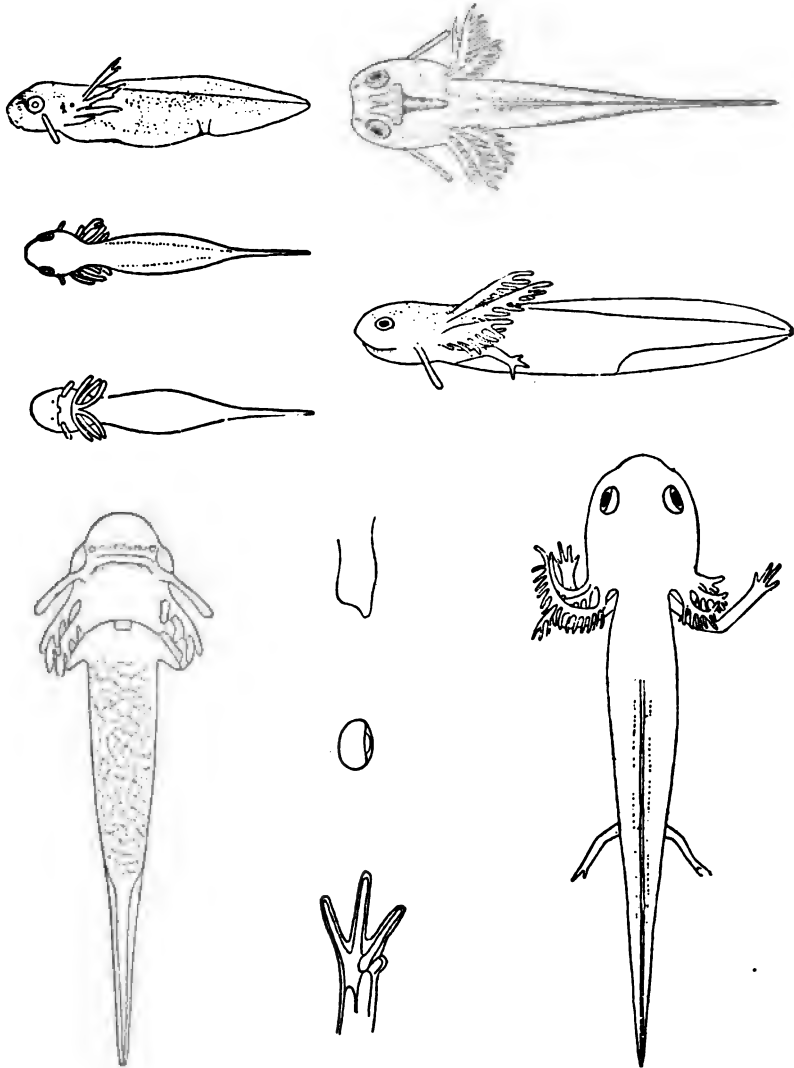
This salamander has a broad body which is swollen and depressed. Dorsal groove strong. Tail about $2\frac{1}{3}$ in length. Cos-



Spotted Salamander. *Ambystoma punctatum* (Linnæus).

tal grooves usually 11, sometimes 10. Skin punctate with small pores which exude a milky fluid. Several clusters of enlarged pores on head. Tubercles on hands and feet indistinct. Color in life black with a series of round yellow spots on each side of back. Length about 6 inches.

Known from within the limits of the state by Dr. Abbott's reference, and that of Mr. Sherwood, who found it at Fort Lee. It is said to occur under logs and stones in clearings. The eggs are laid in large masses in April. At this time the adults seek the swamps. I have no examples.



Spotted Salamander. *Ambystoma punctatum* (Linnæus). (Development of young.)

Amblystoma punctatum Abbott, Geol. N. J., 1868, p. 804.—
Sherwood, Proc. Linn. Soc. N. Y., 1894-95, No. 7, p. 21.

***Ambystoma conspersum* Cope.**

PLATE 4.

Speckled Salamander.

Body slender, and tail shorter than head and trunk together, or about $2\frac{1}{2}$ in length. No dorsal groove. Costal grooves usually 11. Skin smooth. Soles of hands and feet without distinct tubercles. Color in life leaden, with 1 or 2 series of small yellowish spots along sides. Size small.

Known from within our limits by Dr. Abbott's reference. Dr.



Speckled Salamander. *Ambystoma conspersum* Cope.

Abbott tells me that he secured a single example of this species, the basis of his reference, in the valley of a brook between Lawrence and Trenton. This, he says, was identified by Cope. I have no examples.

Amblystoma conspersum Abbott, Geol. N. J., 1868, p. 804.

***Ambystoma bicolor* Hallowell.**

PLATE 5.

Ring Necked Salamander.

Head 6; depth $9\frac{1}{4}$; width of head $1\frac{1}{2}$ in its length from snout to gular fold; length of mouth, or gape, $1\frac{4}{5}$; interorbital space, measured from eye-sockets, $3\frac{1}{6}$; width of mouth $1\frac{1}{2}$; snout $3\frac{2}{5}$; fore limb about 1; hind limb barely more than length

of head; tail $1\frac{1}{4}$ in rest of body. Body stout, heavy, cylindrical, and with little swollen appearance. Surface all rounded, smooth and convex. Trunk rather cylindrical, depressed. Costal grooves 12, counting inguinal. Pelvic grooves obsolete. Grooves on tail obsolete over most of its length. Tail rather long, deep, compressed, somewhat ellipsoid in cross-section, surface smooth, and without keel. Middle of back with a faint longitudinal groove, and extending from occiput to tail above. Lateral groove on tail obsolete. Head obtuse, broad, depressed both above and below, and edges above only largely convex. Profile rather obtuse in front. Snout with length a trifle more than twice in width, apparently about even with closed mandible, and broadly and evenly convex when viewed above. Eye a little elongate or ellipsoid, of moderate size, elevated, and placed near first $\frac{3}{8}$ in length of head. Eyelids fleshy and well developed. Pupil circular. Mouth broad, and when viewed from below similarly convex to snout as seen from above. Lips rather firm, little developed. Vertical constriction behind angle of mouth obsolete, and next, in front of shoulder, but little developed, though horizontal connecting groove more distinct than either. A series of minute teeth along edge of each jaw, numerous and even. Palatine teeth in apparently a long narrow single transverse band presenting a brush-like median appearance made up of a pair of clusters, each of which is barely a fourth longer than either distal cluster or series. Tongue large, disciform, rounded, not emarginate behind, fleshy, largely filling mouth, and surface finely plicate. Interior nares just before outer portion of each end of palatine teeth. Exterior nostrils near front edge of snout, inconspicuous, rather small, and space between a little less than bony interorbital space. Internasal space a little convex. Interorbital space barely convex, nearly flat or level. Skin perfectly smooth, under a lens showing minute simple pores everywhere, though obsolete and few on lower surface. These pits or pores apparently connected with glands. No conspicuous large superorbital and lateral frontal pores apparent. Fore limb inserted at first fifth of body, and reaches about $\frac{5}{8}$ to hind limb. Digits

rather linear, not especially elongate, stout, conic, hardly depressed basally, and without web or outer margin. Third finger longest, 3 in rest of arm, first shortest, and fourth a little shorter than third. Hind limb inserted much nearer tip of snout than tip of tail, and reaching 3 to latter. Fourth toe longest, about 3 in rest of leg, fifth shortest, and second a little shorter than third. Soles of each foot with 2 well-marked, though small, tubercles. Vent large, longitudinal, and just after hind legs on lower surface of trunk. Color in alcohol dull brownish, pores on skin producing a paler or minutely pale-spotted or dotted appearance on upper surface of body. Lower surface of body pale, almost uniform dull brownish-white or creamy-whitish. At present inferior rising of yellowish on side in small obsolete blotches, also several ill-defined yellowish spots. Parotid region dull creamy-yellow with a slightly darker brownish transverse band, about width of iris, from behind rictus up and over to opposite side. Behind this another similar paler band from each shoulder. Limbs brownish, paler on lower surfaces, and darker cross-bands on upper surfaces hardly distinct. Tail pale creamy-brownish with a few rather large brownish blotches rather irregularly distributed. Iris dusky-brown. Length $5\frac{1}{2}$ inches. Type of *Ambystoma bicolor* Hallowell. Beesley's Point. Samuel Ashmead.

This is the only example I have seen. Hallowell states that its color was "blackish above, sides with yellow, tail yellow, and back marked and spotted." Cope next states "color above, olive brown, below yellowish, olive shaded in middle." The only other examples known seem to be those Cope noted, one from the above or type locality, and Alabama. The latter differ a little, however.

Ambystoma bicolor Hallowell, Proc. Acad. Nat. Sci. Phila., 1857, p. 215.

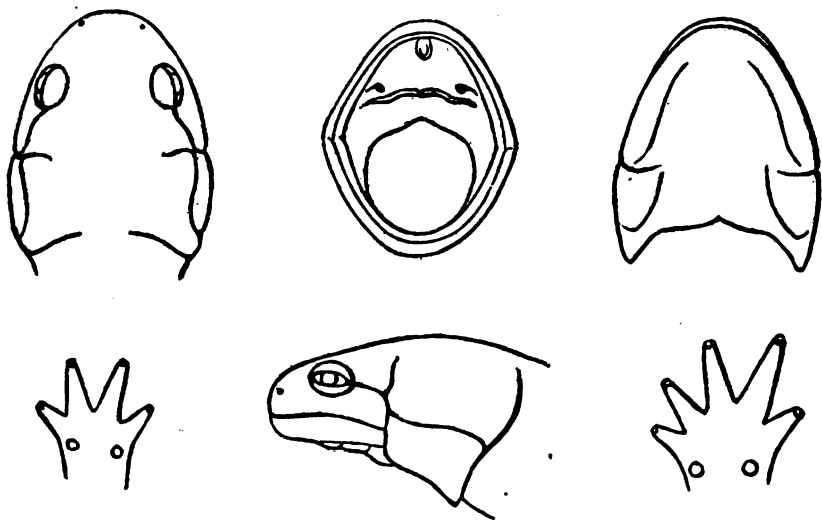
Ambystoma bicolor Cope, Proc. Acad. Nat. Sci. Phila., 1867, p. 178 (type).—Cope, Bull U. S. Nat. Mus., No. 34, 1889, p. 66 (type).—Stone, Am. Nat., XL, 1906, p. 160 (type).

Ambystoma tigrinum (Green).

PLATE 6.

Tiger Salamander. Tiger Triton.

Head 6; depth $8\frac{1}{5}$; width of head $1\frac{1}{2}$ in its length from snout to gular fold; length of mouth, or gape, $1\frac{3}{4}$; interorbital space, measured from eye-sockets, $3\frac{1}{3}$; width of mouth $1\frac{2}{3}$; fore limb about 1; hind limb a little more than head; tail $1\frac{1}{4}$ in rest of body. Body stout, rather thick, of massive appearance. Surface

Tiger Salamander. *Ambystoma tigrinum* (Green).

all rounded, smooth and convex. Trunk swollen, large, slightly depressed. Costal grooves 13, counting inguinal, and about 4 or 5 well-developed pelvic grooves. Scapular groove also evident. Grooves on tail at first more or less evident but becoming obsolete posteriorly. Tail rather long, subquadrate at base, its width at that point $\frac{4}{5}$ its depth, immediately becomes oval in cross-section with bulge above, and posteriorly more or less decidedly compressed for a good space to its tip. Tail with upper and lower surfaces more or less keeled to tip, though about terminal third of its length sharp both above and below. Tip with an

obtuse point seen in profile. Lateral groove on tail not evident. Back from nape till about opposite fifth costal groove with an obsolete median keel, and after this to tail a well-developed median longitudinal groove. Head proportionately small, apparently a little less in width than that of body, obtuse, broad, depressed especially below, and above more evenly convex. Profile a little narrowly rounded in front. Snout with length a trifle more than twice in its width, closed mandible apparently a little included or inferior, and broadly and rather evenly convex when viewed from above. Eye elongate, ellipsoid, rather small, elevated, and placed near first $\frac{3}{5}$ in length of head. Eyelids fleshy, and well developed. Pupil circular. Mouth broad, and when viewed from below similarly convex to that of snout as seen from above. Lips rather firm, little developed. Postriatal transverse or vertical groove obsolete, or short, connected above in front with an oblique groove extending to eye, and posterior transverse groove just before shoulder very pronounced and overlapping, and lateral annectant horizontal groove rather obsolete. Neck decidedly constricted so that parotid region is much swollen, wider than skull, and about equal to space between tip of snout and first postriatal transverse groove. Teeth in jaws in a single series, minute, numerous and even. Palatine teeth in apparently a narrow long \wedge -shaped single transverse band, extending nearly across to either side of upper jaw, not interrupted, and angle behind extending forward till about opposite middle of internal nares. Tongue large, fleshy, disciform, rounded, plicate, and plicated surface slightly emarginated behind. Internal nares placed about opposite each edge of interorbital space measured from sockets, so that space between is about same distance. Exterior nostrils near front edge of snout, inconspicuous, rather small, and space between about $1\frac{2}{5}$ in bony interorbital space. Internasal and interorbital regions a little convex, though broad. Skin smooth, when removed seen everywhere closely covered with shallow pits interspersed with granule-like projections of glands. Pores obsolete. Fore limb inserted at first fifth in body, reaches $\frac{4}{7}$ to hind limb, and moderately stout. Digits much depressed, not especially elongated, elongately triangular, or tapering from a rather broad base to

hardened and somewhat horny tips, not webbed and each with a somewhat obsolete keel along its edge. Third finger longest, 4 in rest of arm, first and fourth subequal and shortest. Hind limb inserted much nearer tip of snout than tip of tail, reaching nearly 3 to latter, stout, thickened and short in proportion. Fourth toe longest, about 3 in rest of leg, first shortest, and second and fifth about equal or shorter than third. Soles of each foot with 2 well-marked tubercles. Vent a moderate longitudinal slit, just after hind legs on lower surface of trunk. Color in alcohol dull muddy-brown above, a trifle paler on sides, and becoming dull pale creamy-brown on under or lower surface. Back and head above, also side, which are formed of transitory mottlings of lower surface, finely though rather sparsely spotted with dull creamy-brownish. On tail these spots become still less numerous and larger, and on costal region, as mentioned, they form a mottled appearance. Mandible pale. Upper surfaces of limbs brownish like back, similarly spotted or speckled, and lower surface pale like belly and unspotted. Iris deep brownish. Length $6\frac{1}{4}$ inches. Beesley's Point. Dr. G. H. Horn.

Color in life blackish-brown. Upper surface of head dull olivaceous-brown. Blotches irregularly down median dorsal line same color on flanks, on side of tail they become paler, brighter or a dull yellowish-olive, and on under surface of an altogether more yellowish tint. They rise on sides as a close series. Under surface of head yellowish. Breast and median line of belly blotched with yellowish. Feet and legs with large blotches of yellowish. Iris slaty-dusky. Soles of feet dull brownish or dusky. Length $7\frac{5}{8}$ inches. Mullica Township, Atlantic County. November 14th, 1905. Stephen Milstead, Sr.

I also have other examples from Beesley's Point (Samuel Ashmead), and 1 without definite locality (Dr. J. E. Holbrook). This material shows considerable variation in color, especially with reference to the spots. They all show the pale spots larger than in that first described, most numerous or crowded on the sides; and varying in size. The largest example is $9\frac{1}{2}$ inches long. This species is of great interest on account of its metamorphosis, the branchiferous axalotls of Mexico if not be-

lieved to be same are at least very closely related. They have been seen to complete their metamorphosis, and can breed while still branchiferous, though the persistence in that stage for any great length of time is probably due to their forced aquatic surroundings. They are said to complete their metamorphosis at times in late summer and then take up terrestrial life, hiding in holes, etc., from which they emerge frequently after rains. Cope states that New Jersey examples are almost always more fully developed than western ones, and suggests that it may be due to the former district being warmer than the latter. In captivity they have been found to feed on small frogs. Dr. Abbott tells me he once saw a single example at Princeton along the edge of a brook.

Salamandra tigrina Green, Journ. Acad. Nat. Sci. Phila., V, pt. 2, 1825, p. 116.—Harlan, Journ. Acad. Nat. Sci. Phila., V, pt. 2, 1827, p. 328 (evidently reference).—Harlan, Med. Phys. Res., 1835, p. 93 (copied).—Holbrook, N. Am. Herp., III, 1838, p. 109, Pl. 25.

Triton tigrinus Holbrook, l. c., Ed. 2, V, 1842, p. 79, Pl. 26.

Ambystoma tigrinum Hallowell, Proc. Acad. Nat. Sci. Phila., VIII, 1856, p. 7.—Baird, Journ. Acad. Nat. Sci. Phila., (2) III, 1855-58 (January, 1858), p. 350.

Amblystoma tigrinum Cope, Proc. Acad. Nat. Sci. Phila., 1867, p. 179.—Abbott, Geol. N. J., 1868, p. 804.—Abbott, Nat. Rambles, 1885, p. 477.—Cope, Bull. U. S. Nat. Mus., No. 34, 1889, p. 68, Pl. 25, fig. 7.—Sherwood, Proc. Linn. Soc. N. Y., 1894-95, No. 7, p. 28.—Stone, Am. Nat., XL, 1906, p. 160.

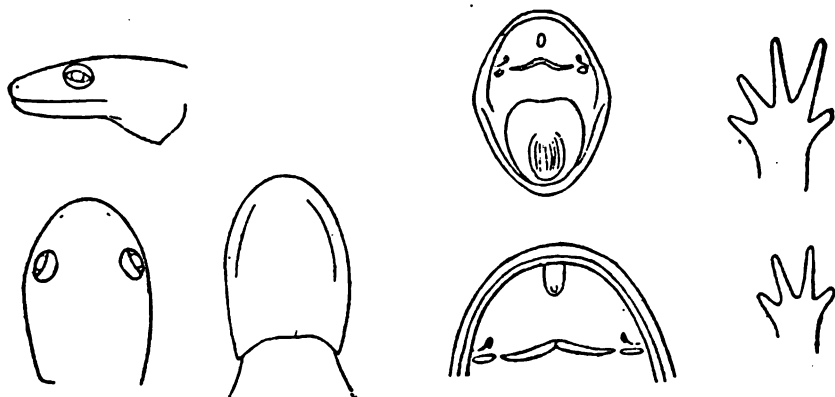
Ambystoma jeffersonianum (Green).

PLATE 7.

Jefferson's Salamander.

Body slender, and fore limb not reaching hind limb when appressed. Costal grooves usually 12. Head small. Eyes far back. Palms of hands and soles of feet with or without an indistinct tubercle. Color in life olive-brown or blackish, usually

with pale or bluish spots, though sometimes uniform plumbeous. Length as much as 8 inches. Variable.



Jefferson's Salamander. *Ambystoma jeffersonianum* (Green).

Recorded by Dr. Abbott. I have no examples.

Amblystoma jeffersonianum Abbott, Geol. N. J., 1868, p. 804.

Family PLETHODONTIDÆ.

The Red Backed Salamanders.

Vertebræ amphicelous, simple below. Ethmoid wanting. No pterygoid. Carpus and tarsus cartilaginous. Vomero-palatine bones not produced posteriorly over parasphenoid, and dentigerous plates on latter. Ceratohyal undivided, articulating directly with quadrate bone or cartilage. No otohyal. Only 1, or first basibranchial, in adults, and second basibranchial not connected with first. Stapes not connected with quadrate by cartilage in adults. Vestibule with inner wall osseus.

The species of this natural and well-defined family are all, with one exception, American. Many are of small size, some very small, and others are handsomely colored. All are distinguished for their power of projecting the tongue, sometimes for a distance equal to half the entire length of the animal.

Key to the genera.

- a. PLETHODONTINÆ. Tongue attached by a band extending from its central or posterior pedicel to the anterior margin.
 b. Toes 4—4. HEMIDACTYLIUM
 bb. Toes 4—5. PLETHODON
 aa. SPELERPINÆ. Tongue free all around, attached by its central pedicel only.
 c. Two premaxillary bones, with fontanel. GYRINOPHILUS
 cc. One premaxillary bone, with fontanel. SPELERPES

Genus HEMIDACTYLIUM Bonaparte.

The Four Toed Salamanders.

Hemidactylium scutatum Tschudi.

PLATE 8.

Four Toed Salamander. *Hemidactylium scutatum* Tschudi.

Four Toed Salamander.

Head $7\frac{1}{2}$; depth about $14\frac{1}{3}$; width of head about $13\frac{1}{5}$ in its length from snout to gular fold; length of mouth, or gape, about $1\frac{5}{6}$; interorbital space, measured from eye-sockets, about $3\frac{1}{2}$; width of mouth $1\frac{2}{3}$; fore limb about $1\frac{1}{8}$; hind limb about $1\frac{1}{8}$; head and trunk about $1\frac{1}{5}$ in tail. Body rather robust, elongate, more or less depressed below anteriorly, and rounded convexly above. Surface all rounded, smooth and convex. Trunk not swollen, convex above, and somewhat depressed below. Costal grooves 13, counting axillary and inguinal, well-marked, and more or less continued over abdomen. At an acute angle proceeding backwards from dorsal line are grooves corresponding in number and uniting with lines directed at less acute angle from upper ends of costal grooves. A rather obsolete longitudinal

keel marks upper boundry of costal grooves on each side and outline of back. Grooves on tail conspicuous, first extending across lower surface, only becoming obsolete towards tip, and about 30 distinct. Longitudinal keel along side of back, only distinct on tail above anteriorly. Tail long, compressed with constriction below so that it is oval in cross-section most of its length, and swelling a little from base where slightly constricted all around. Upper edge of tail with a low keel only on its terminal $\frac{2}{3}$, while below its entire edge furnished with a median keel just after vent. Tail with a rather slender tip, as seen in profile. A median groove extends down back from occiput till opposite origins of hind limbs, and at former point it bifurcates, sending a branch to each eye. Head rather small, broad as wide, if not a trifle wider than greatest width of body, very obtuse, and depressed both above and below. Profile blunt and obtuse, angle forming nearly midway in its depth. Snout with length a trifle more than twice in its width, projecting well beyond closed mandible, and broadly convex when viewed from above. Eye elongate, ellipsoid, small, and placed near first third in length of head. Eyelids fleshy and moderately developed. Pupil circular. Mouth broad, and when viewed from below seen to be more evenly convex than blunt profile of snout or upper jaw. On each side of upper jaw, when seen from below, fleshy edge bulging out. Lips firm, little developed. Postrictal transverse or vertical groove obsolete, developed as a slight bifurcation at branch from lower postocular groove. Following, another similar transverse groove crossing over lower postocular groove and uniting at junction of upper ocular grooves at occiput. A short space behind this still another, also crossing lower postocular groove to median dorsal groove. Then gular groove, which is continued all around on sides and lower surface, and there overlapping. Neck decidedly constricted behind so that parotid region is much swollen, at least equal to width of skull. Teeth in jaws in a single even series, small, and not especially numerous. Palatine teeth minute, arranged in 2 small patches convergent backwards, though separated. Tongue moderately large, somewhat heart-shaped or with slight emargination posteriorly at end of plicated surface. Each of internal nares a little

in advance of end of outer portion of palatine patch of teeth, and falling a little nearer each other than bony space across interorbital width. Exterior nostrils near front edge of snout, and a trifle closer together than bony interorbital space. Internasal space convex, and interorbital space flattened or level. Skin beautifully granulated or corrugated, though rather smoothly so, and not rough to touch. Pores obsolete. Fore limb inserted at first sixth in body, reaches half way to hind limb, and rather small. Digits rather depressed, short, of more or less similar even width, not webbed and without keels, surfaces convex. Third finger longest, about 6 in rest of arm, and first and fourth subequal and very short. Hind limb inserted near first $\frac{3}{5}$ in length of body, and reaching about $5\frac{1}{2}$ in tail to its tip. Third toe longest, nearly 5 in rest of leg, first shortest, and fourth much shorter than second. Vent a longitudinal slit just after hind legs on lower surface of tail. Color in alcohol back and upper surface generally rather dull brown, and upper surface of head and tail generally a little darker than that of tail, which is ochraceous tinted. Lower surface of body pale creamy-white, which color extends all way from snout to tip of tail. Snout above, and around edges creamy-brown, dotted minutely with dusky. Top of head, back, and tail above, all with some rather obscure scattered specks or small irregular spots of dusky. From postocular region along each side of trunk and tail, a slightly paler tint than general dorsal color, though annectant below a darker color. This darker color made up of a rather regular series of irregularly distributed dusky spots, usually 1 in or at each costal groove. On corresponding lower edge of body, from breast along below limbs out towards end of tail, a series of deep dusky or blackish spots. Just above these, a narrow pale or grayish area. Median line of belly and lower surface of head with similarly pronounced blackish spots. Several blackish spots from below eye back to shoulder. Upper surfaces of limbs brownish like belly, though specked with darker, and forming 3 or 4 irregular transverse bands or bars. Under surface of limbs creamy basally, but becoming brownish on outer portions. Iris slaty, eyelids speckled brownish. Length $2\frac{1}{2}$ inches. Swartzwood Lake, Warren County. October, 1895. Samuel N. Rhoads.

Also 4 others, all smaller, with same data. This little salamander is found in the northern or upland portions of our state, and is entirely terrestrial. The only examples I have seen were those taken by Mr. S. N. Rhoads. They were found under logs. Dr. Dahlgren tells me this species was very common in the vicinity of Princeton, and that he has secured as many as 50 individuals.

Hemidactylium scutatum Sherwood, Proc. Linn. Soc. N. Y., 1895-96, No. 7, p. 30.—Stone, Am. Nat., XL, 1906, p. 160.

Genus *PLETHODON* Bonaparte.

The Slimy Salamanders.

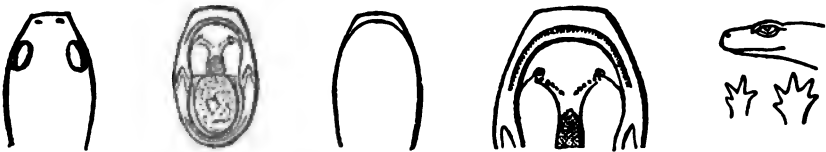
Key to the species.

- a. Form slender; vomerine teeth not extending beyond nares externally; costal grooves 16 to 19; tail cylindrical; limbs weak; inner toes rudimentary; belly brown marbled; above plumbeous or with a red longitudinal band. ERYTHRONOTUS
- aa. Form stout; vomerine teeth extending outside of inner nares; costal grooves 14; tail rounded; limbs short, stout; inner toes distinct; black, usually with gray lateral blotches and smaller dorsal spots. GLUTINOSUS

Plethodon erythronotus (Green).

PLATE 9.

Red Backed Salamander. Dapple Salamander.
Gray Salamander.



Red Backed Salamander. *Plethodon erythronotus* (Green).

Head $9\frac{1}{3}$; depth 14; width of head $1\frac{1}{2}$ in its length from snout to gular fold; length of mouth $1\frac{4}{5}$; interorbital space, measured from eye-sockets, 5; width of mouth $1\frac{3}{5}$; fore limb about $1\frac{1}{4}$; hind limb a trifle more than head; head and trunk a trifle more than tail measured from just behind vent. Body

elongate, slender and cylindrical. Surface all rounded, smooth, and especially convex. Trunk not especially swollen, though largely cylindrical. Costal grooves 19, counting axillary and inguinal. About 4 pelvic grooves. No scapular groove between gular fold and axillary groove. About 36 grooves on side of tail, most distinct towards base and obsolete towards tip. Grooves also more or less obsolete or fading out altogether on middle areas of back and abdomen. No keel along upper side of body. None of grooves on tail joined to their fellows on its lower surface. No distinct groove longitudinally on entire upper surface or lower surface, tail being perfectly convex. Tail cylindrical in cross-section, only very slightly compressed towards its tip, which is slenderly acuminate. Head rather small, broad, depressed both above and below, its width about equal to greatest of body, obtuse in profile and its angle forming a little low in depth. Snout about twice as broad as long, projecting much beyond closed mandible, and broadly convex when viewed from above. Eye a little elongate, ellipsoid, well elevated, small, and placed near first third in length of head. Eyelids fleshy and well developed. Pupil circular. Mouth broad, and when viewed from below seen to be more evenly convex than broader upper projecting edge of snout or upper jaw. Lips thin, little developed, and firm. Postrictal transverse or vertical groove obsolete. A similar second postrictal transverse groove between it and gular fold, which follows. Gular groove or fold well developed, not passing over nape, though overlapping on neck below. From eye to shoulder a slight ridge extends back and joins all grooves in course mentioned. Neck a little constricted, though parotid region not quite swollen to width of skull. Teeth in jaws in a single even series, small and not especially numerous. Palatine teeth minute, arranged in 2 small patches convergent backwards, though separated. Tongue large, rounded, though a little longer than deep, and with spongy plicated surface. Internal nares would fall within bony interorbital space, and each not far from middle of length of each band of palatine teeth. Exterior nostrils close along front edge of snout, and also falling within limits of bony interorbital width. Internasal space convex, and inter-

orbital space flat or level. Skin smooth to touch, pitted with minute pores, imbedded and most numerous developed above over most all of its surface, though below they become obsolete. No external pores, or if present obsolete. Fore limb inserted about first $\frac{2}{15}$ in body, reaches $3\frac{1}{2}$ to hind limb, small and weak. Digits small, depressed, rather broad, short, with tips rounded, and without webs or keels. Third finger longest, about 6 in rest of arm, first shortest and obsolete, and fourth a little shorter than third. Hind limb inserted about first $\frac{4}{9}$ in body, and reaching about $5\frac{3}{5}$ in tail to its tip. Third toe longest, about 4 in rest of leg, first shortest and obsolete, fifth a little shorter than second, and fourth a trifle longer than second. Vent a rather short longitudinal slit just after hind legs on lower surface of tail. Color in alcohol generally faded dull muddy-brown, entire back till level with a line drawn along each side from eye to tip of tail paler than sides, which are soiled slightly with darker. This darker lateral color equally apparent on sides of head, neck and tail, and though somewhat darker and more pronounced on its upper area for a large part, persists below as more or less soiled specks over most all of under regions. Tail also darker on sides and under surface, medianly paler. Limbs darker above and paler beneath, also speckled with a slightly darker tint. Iris slaty-brownish. Length $3\frac{1}{2}$ inches. Cotype of *Salamandra erythronota* Green. New Jersey [probably near Princeton?]. Prof. Jacob Green.

Also 11 other cotypes, among which are some cotypes of *Salamandra cinerea* Green, with same data. These examples have all been in alcohol for many years, and though their color has all more or less faded some of the pattern is still evident. The very pale-backed example may have been Green's type of *erythronota* while the darker-backed ones may more properly be referred to *cinerea*. In order to determine the respective cotypes of these 2 nominal species the original diagnosis of Green is found to be very unsatisfactory. He states under *erythronota* that the tail is rather shorter than the body, and though some of the examples have it so they are certainly similar in all other respects to those which would be likely to be *cinerea*. It may also be noted in this con-

nection that *erythronota* has priority over *cinerea* by right of sequence on the same page, and therefore is adopted here.

This little salamander is entirely terrestrial in its mode of living, and is said never to occur in water, even in its larval life. The eggs are laid in a little cluster in some damp place, usually beneath a stone. When first hatched the young have branchiæ which soon disappear, and when found in this young stage appear quite developed. In the high dry mountains, and most always away from streams and water, these animals live. They occur under bark, logs, leaves and more frequently stones. I have sometimes, though rarely, found them in open places, usually in woodland, especially along the slopes of hills or mountains. They are somewhat variable in color, especially the back, which varies from a dark liver-brown to light reddish, and which may be shaded with rose-color to yellowish. It does not appear to me to be so abundant as the *Desmognathus fusca*, or dusky salamander, which also ranges into the same territories. From this latter variable species, with which it may be confounded, I find a good character to distinguish the latter in the whitish or light streak sloping down posteriorly from the eye. This, *Plethodon erythronotus* never has. The food consists of insects and their larvæ, which are captured by means of its flat projectile tongue. I have examined a number of examples collected by Mr. S. N. Rhoads in Sussex County during October of 1896, others from Swartzwood Lake and Cedar Lake during October of 1895, and Alpine in Bergen County. In the latter district it is also known from about Ridgewood. Some very small examples have broad heads and bright or light brick-red backs.

Color in life of adult, above livid dusky everywhere, sprinkled with obscure grayish mottlings. An indistinct median warm brown tinge, more reddish on pelvic region, and fading out into greenish-gray on tail. Lower surface of head translucent brownish, and rest of body grayish. Feet translucent brownish, also tail below. Iris dusky. This example from under a log near Kinkora, Burlington County, in October, 1906. Found abundantly under logs and sticks along the banks of Kinkora Creek and south-east of Bordentown. Many examples were completely intergrading from the red-backed to the liver-colored

forms, all about this locality, very often both under the same log. They were not especially active and would twist in serpentine contortions when taken in the hand. Although secreting a slime it was not so powerful as that of *Plethodon glutinosus*. About Trenton Dr. Abbott finds it in dry woods, away from water, under-stones, logs, etc. He has met with it in early spring. Mr. S. H. Hamilton secured it near Mantua early in April of 1906. Mr. Witmer Stone claims that in his experience that this species and *Plethodon glutinosus* are nowhere equally abundant, one or the other always predominating. I have on different occasions found or seen several specimens, some of the present species being positively identified, and therefore not to be confused with *Desmognathus fusca*, in the same localities frequented by *Plethodon glutinosus*. This would however seem rather exceptional.

Salamandra erythronota Green, Journ. Acad. Nat. Sci. Phila., I, pt. 2, 1818, p. 356.—Harlan, Journ. Acad. Nat. Sci. Phila., V, pt. 2, 1827, p. 329.—Harlan, Med. Phys. Res., 1835, p. 95.—Holbrook, N. Am. Herp., III, 1838, p. 113, Pl. 27 (ref. infers).

Plethodon erythronotus Abbott, Geol. N. J., 1868, p. 803.

Salamandra cinerea Green, l. c.—Harlan, Journ. Acad. Nat. Sci. Phila., V, pt. 2, 1827, p. 330.—Harlan, Med. Phys. Res., 1835, p. 95.

Plethodon cinereus Abbott, l. c.—Stone, Am. Nat., XI, 1906, p. 160.

Plethodon cinereus erythronotus Sherwood, Proc. Linn. Soc. N. Y., 1894-95, No. 7, p. 31.

Plethodon cinereus cinereus Sherwood, l. c.

***Plethodon glutinosus* (Green).**

PLATE 10.

Sticky Salamander. Slimy Salamander. Blue Spotted Salamander.

Head $6\frac{3}{4}$; depth $1\frac{3}{2}$; width of head $1\frac{3}{4}$ in its length from snout to gular fold; length of mouth 2; interorbital space, measured from eye-sockets, $4\frac{1}{3}$; width of mouth $1\frac{3}{4}$; fore limb about

$1\frac{1}{10}$; hind limb a trifle more than head; tail measured from just behind vent, $1\frac{1}{8}$ in rest of body. Body slightly depressed, moderately slender and cylindrical generally. Surface rounded, smooth and convex. Trunk not swollen, rather evenly cylindrical. Costal grooves distinct on sides, interrupted on back and belly, and 16 in number including 1 axillary and other at groin. No distinct grooves on pelvic region, and anteriorly on sides of tail traces of rather obsolete ones. No scapular groove between gular fold and axillary groove. No keel along side of body either above or below. A very shallow obsolete furrow along median line of back, but not on tail above or below. Tail cylindrical, becoming somewhat cylindrico-quadrate basally and compressed towards tip, which is slenderly acuminate with well convex edges. Head large, broader than greatest width of body, depressed both above and below, greatest width about posterior



Sticky Salamander. *Plethodon glutinosus* (Green).

edges of eyes, and obtuse in profile with its angle forming about midway in depth. After eyes sides converging towards neck, which has a somewhat constricted appearance as seen from above. Snout twice as broad as long, projecting much beyond closed mandible, and rather bluntly convex as viewed from above. Eye a little ellipsoid, well elevated, small, and placed about first third in head. Eyelids fleshy and well developed. Pupil circular. Mouth broad, and when viewed from below seen to be more evenly bent or convex than edge of upper jaw. Lips thin, hard or firm, and upper sloping inferiorly with bevelled surface. Post-riatal transverse groove distinct, joining postocular groove which continues posteriorly, and unites with gular fold on side of neck. Gular fold well developed. Parotid region not especially swollen.

Teeth in jaws minute, uniserial, even and numerous. Palatine teeth minute, arranged in 2 small convergent patches directed backwards, though distinctly separated. Tongue large, oval, longer than broad, fleshy, becoming thin marginally, where it is free, and its surface densely plicated or papillose. Papillose surface with its area emarginated behind. Internal nares would fall just within bony area of interorbital space as seen from above, and each placed just before outer extremity of each patch of palatine teeth. External nostrils close along front edge of snout, and placed a little outside of least bony width of interorbital space. Internasal space convex, and interorbital space flattened. Skin perfectly smooth to touch, closely lined everywhere with short perpendicular glands secreting a milky juice, largest on upper surface of tail, and more scattered on belly. When mucous is removed skin seen to be closely covered with shallow pits. No large pores in patches on head. Fore limb inserted about first $\frac{2}{11}$ in body, reaches half way to hind limb, and moderately developed. Digits short, depressed, broad, rather linear, slightly swollen into knobs at end, and without keels or disks. A short thick membrane connects basal joints leaving $2\frac{1}{2}$ phalanges free of fingers, and 3 of longer toes. Third finger longest, about 3 in rest of arm, first shortest, and second longer than fourth. Hind limb inserted about first $\frac{5}{11}$ in body and reaching 3 in space to tip of tail. Third toe longest, about 4 in rest of leg, fourth but a trifle shorter, first shortest and fifth a little shorter than second. Vent a longitudinal slit just behind hind limbs on lower surface of trunk. Color in alcohol livid slaty-black, upper surface and sides marked with well-defined grayish specks, and most numerous on latter, especially below. They have a silvered or glittering appearance like torn foil. Under surface of body soiled brownish-white. Lower surface of tail pale slaty. Feet pale brownish. Iris slaty. Length $2\frac{7}{8}$ inches. Swartzwood Lake, Warren County. Samuel N. Rhoads.

Also 2 others with same data. This species appears to vary but little, though sometimes the back is apparently destitute of spots. It is found chiefly among rocks, logs, leaves, etc., in the upland or mountain forests. It is also entirely terrestrial in its

habits. It is remarkable for the viscous or powerful sticky secretion which it exudes, and after one is taken in the hands this is not easily cleansed. The only examples which I have examined from within our limits are those mentioned above. It may be more abundant in the northern region of the state, and overlooked on account of its retiring habits.

Salamandra glutinosa Green, Journ. Acad. Nat. Sci. Phila., I, pt. 1, 1818, p. 357.—Harlan, Journ. Acad. Nat. Sci. Phila., V, pt. 2, 1827, p. 330.

Plethodon glutinosus Abbott, Geol. N. J., 1868, p. 803.—Cope, Bull. U. S. Nat. Mus., No. 34, 1889, p. 139, Pls. 26 & 31 fig. 6, 35 fig. 2, 40 fig. 4, 45 fig. 5, 48 fig. 14.—Sherwood, Proc. Linn. Soc. N. Y., 1894-95, No. 7, p. 32.—Stone, Am. Nat., XL, 1906, p. 161.

Genus *GYRINOPHILUS* Cope.

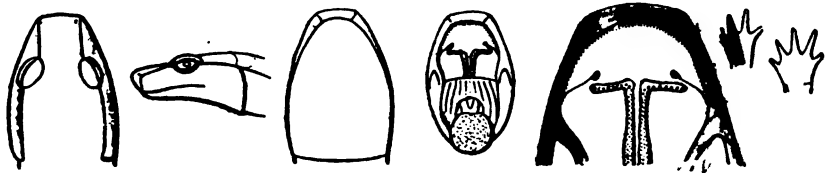
The Purple Salamanders.

Gyrinophilus porphyriticus (Green).

PLATE II.

Purple Salamander. Porphyritic Salamander.

Costal grooves 14. Head broad. Tail rounded at base, not finned. Color in life yellowish, flesh-colored or purplish-brown



Purple Salamander. *Gyrinophilus porphyriticus* (Green).

above, and irregularly speckled with gray or brownish. Length 6 inches.

Although Dr. Abbott states he has met with this species about Trenton, and that it occurs in central New Jersey, it is more likely to be found in the northern or mountainous regions of the State. I have never seen any New Jersey examples. Cope states

that it is the only one of our eastern salamanders which attempts self-defence as it snaps fiercely, but harmlessly, and throws its body into contortions. This is not altogether true as I have seen *Plethodon glutinosus* attempt to bite a little when captured in the hand.

Gryinophilus porphyriticus Abbott, Nat. Rambles, 1885, p. 477.

Pseudotriton salmonea Abbott, Geol. N. J., 1868, p. 803.

Genus SPELERPES Rafinesque.

The Long Tailed Salamanders.

Key to the species.

- a. Vomerine teeth not continued posteriorly to parasphenoid patches, nor exteriorly beyond nares; costal grooves 13 or 14.
 - b. Tail short, or about equal to rest of body. BISLINEATUS
 - bb. Tail long, or about $1\frac{1}{2}$ to twice as long as rest of body. LONGICAUDA
- aa. Vomerine teeth in a continuous series posteriorly with those on parasphenoid, and originating behind nares; costal grooves 15 or 16. RUBER

Spelerpes bislineatus (Green).

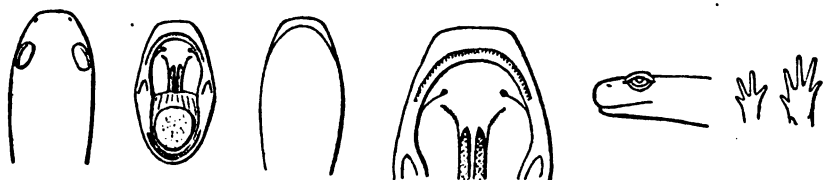


PLATE 12.

Two Lined Salamander.

Head 8; depth $1\frac{7}{4}$; width of head $1\frac{3}{5}$ in its length from tip of snout to gular fold; length of mouth $2\frac{1}{4}$; interorbital space, measured from eye-sockets, 5; width of mouth 2; fore limb about $1\frac{1}{4}$; hind limb a trifle more than head; tail measured from just behind vent about once and width of mouth in length of head and trunk. Body somewhat depressed above and below, slender, elongated, and otherwise more or less cylindrical with convex edges. Surface rounded, smooth and convex. Trunk not swollen, slender, hardly constricted either in front or behind. Costal grooves not especially pronounced, rather obscure on upper

and lower surfaces, or interrupted, and 16 in number including 1 at axilla and other at groin. Grooves obsolete or absent from pelvic region. Grooves on tail obsolete, those on front or anterior of sides most pronounced. No scapular groove. Gular fold well developed and sloping obliquely forward on neck below. A shallow median groove along middle of back. Edge of back hardly forming a superior keel along each side of caudal. Tail rather compressed, so that transverse section would appear somewhat ovoid, with bulge above towards base. Edge of tail along most of its upper extent with a low keel to tip, and below a similar one most of its distal length. Tail slender, tapering and acuminate. Head large, broader than greatest width of body, depressed both above and below, and greatest width just behind eye. Parotid region hardly swollen. In profile snout obtuse, and angle forming a little superior in depth of head. Snout twice as broad as long.



Two Lined Salamander. *Spelerpes bislineatus* (Green).

projecting much beyond closed mandible, and edge decidedly blunt in its convexity as viewed from above. Eye a little ellipsoid or elongated, not especially elevated, rather small, and placed about first third in length of head. Eyelids rather thin, though well developed. Pupil circular. Mouth broad, and when viewed from below seen to be more evenly convex than edge of upper jaw. Lips thin, rather hard and firm, their surfaces apparently convex. A single series of small or minute even teeth in jaws. Palatine teeth minute, in 2 small convergent patches directed backwards, though separated, and not annectant with parasphenoid patches. Tongue moderately large, rather heart-shaped with posterior emargination not very deep but shallow, becoming free marginally, and its surface finely papillose. Internal nares placed in front of outer ends of palatine patches of teeth, and distance from one another equal to bony interorbital space. External nostrils rather

high along front edge of snout, as far apart as bony interorbital space. Internasal space convex, and interorbital space flat or level. Skin smooth to touch and without evident pores or pits. Fore limb inserted about first $\frac{2}{15}$ in length of body, reaches $2\frac{3}{4}$ to origin of hind limb, and rather small. Digits short, depressed or slightly flattened, not webbed or keeled, and ending in little knobs which are not disk-like. Third finger longest, about $4\frac{1}{2}$ in rest of arm, first shortest, and fourth longer than second. Hind limb inserted near first $\frac{3}{5}$ in body and reaching $4\frac{3}{4}$ to tip of tail. Third hind toe longest, about 4 in rest of leg, first shortest, and fifth a little shorter than second, which is shorter than fourth. Vent close behind hind limbs on lower surface of body. Color in alcohol plain pale brownish, lower surface scarcely paler than back. Along each side of back from behind eye a dull brownish streak, in some places slightly interrupted. Back more or less finely mottled or specked obscurely with brownish, which is scarcely darker than its own general tint. Sides of tail above also tinted with brown. Upper surfaces of limbs obscurely brownish mottled, below pale like belly. Iris slaty. Length $3\frac{9}{16}$ inches. Cotype of *Salamandra bislineata* Green. New Jersey [probably near Princeton?]. Prof. Jacob Green.

Also 3 other cotypes. Besides these I have examined a number of examples from White Pond and Swartzwood Lake (Samuel N. Rhoads), and others from Atlantic City in 1894 (E. D. Cope). Also larvæ, probably this species, taken in Morris County (F. Canefield). Considerable variation is seen in the coloring of this species, some examples having the back nearly uniform over its pale area, save the median pale dusky streak which is obsolete in some, and others with the entire back densely and conspicuously punctuate. Again the punctuations will exhibit a still more contrasted appearance as they are pale in some examples, with blackish or dusky annectant reticulations. The length of the tail is also seen to vary some so that the apparently nominal species *Salamandra haldemani* Holbrook has been thought by Cope to be identical. This is further suggested by the coloration, though it may equally be referred to the *Desmognathus ochrophæa* Cope, which I believe to be a variation or stage

of *D. fusca*. From the *ochrophæa* stage of the latter it may be distinguished, as already pointed out by Cope, and as I have further suggested in comparison with *Plethodon erythronotus*, by the absence of a broad light dark-edged oblique streak passing down from the eye posteriorly behind gape. From both of these salamanders *bislineatus* is seen to be more slender, with a longer slender tail, and the belly yellow. This species is perhaps most always found in the upland country of the state. It is largely aquatic in its habits and is frequently to be found about springs, brooks or other clear cold waters, usually under wet stones. It is only to be found, however, in the shallow waters, and not in deep pools. Frequently one will find all stages of *Desmognathus fusca*, some with backs as red as some of *Plethodon erythronotus*, and *Spelerpes ruber*, all in the same locality, though *S. bislineatus* in my experience is usually the least abundant. Mr. Witmer Stone states that it is rather common. In my experience it is fairly frequent in some localities. It is very active, scampering or wriggling away with great energy. Its metamorphosis is prolonged, sometimes remaining in the larval state till nearly grown. Dr. Abbott found it about Trenton.

Salamandra bislineata Green, Journ. Acad. Nat. Sci. Phila., I, pt. 2, 1819, p. 352.

Salamandra bis-lineata Harlan, Journ. Acad. Nat. Sci. Phila., V, pt. 2, 1827, p. 332.

Salamandra bilineata Holbrook, N. Am. Herp., II, 1838, p. 127, Pl. 29.—Holbrook, l. c, Ed. 2, V, 1842, p. 55, Pl. 16.

Spelerpes bilineatus Sherwood, Proc. Linn. Soc. N. Y., 1894-5, No. 7, p. 31.—Stone, Am. Nat., XL, 1906, p. 161.

Salamandra flavissima Harlan, Med. Phys. Res., 1835, p. 97.

***Spelerpes longicauda* (Green).**

PLATE 13.

Long Tailed Salamander.

Head $9\frac{1}{2}$; depth $19\frac{1}{2}$; width of head $1\frac{7}{8}$ in its length from tip of snout to gular fold; length of mouth 2; interorbital space,

measured from eye-sockets, 5; width of mouth $1\frac{7}{8}$; fore limb a little more than head, though not quite equal to its length when measured to posterior bifurcation of gular fold; hind limb 8 in entire length of body; head and trunk $1\frac{1}{2}$ in tail, latter measured from just after vent to tip. Body depressed both above and below, especially elongated and slender. In form more or less cylindrical, with rounded or convex edges. Trunk not swollen, rather slender. Costal grooves 14, counting 1 at axilla and another at groin. Posterior or inguinal really a bifurcation of thirteenth groove. Grooves absent from pelvic region, and only a few traces of obsolete ones near base of caudal along its sides. Scapular groove really a posterior bifurcation of gular fold, and in turn sending bifurcation to shoulder or axillary groove. Gular fold well developed and sloping somewhat forward on neck below. On back above a slight median groove from occiput to base of tail, and lateral or costal grooves widely separated from it on



Long Tailed Salamander. *Spelerpes longicauda* (Green).

each side by smooth convex area of back, which is not in any way keeled. Belly and lower surface also smooth, costal grooves in no way encroaching. Tail very long, slender, ending in a long acuminate point, compressed, and both upper and lower edges convex, not keeled. In transverse section tail would be more or less entirely ellipsoid. Head large, broader than greatest width of body, depressed both above and below, and greatest width opposite posterior portions of eye, parotid region not swollen. In profile obtuse, and angle forming a little superior in depth of head. Snout broad, a little more than twice as broad as long, projecting much beyond closed mandible, and its edge evenly convex as viewed from above. Eye a little ellipsoid or elongated, not especially elevated, rather small and placed near first third

in head. Eyelids rather thin, though well developed. Pupil circular. Mouth broad, and when viewed below its convexity a little more constricted than that of edge of upper jaw. Lips thin, hard and firm. Upper lip with a slight swelling on each side, giving a broadly convex or somewhat bevelled appearance to front view, and a concavity to lateral outline which posteriorly becomes convex. Also a slight emargination of mandible on each side to fit in. Each jaw with apparently a single series, or very narrow if in more than 1, of small conspicuous uneven teeth. Palatine teeth minute, in 2 small slightly elongated patches convergent towards parasphenoid patches, though separated. Tongue orbicular or barely longer than wide, finely papillose, and with free edges not especially thin. Internal nares placed in front and a little outside of outer ends of palatine patches of teeth, and distant from one another not quite width of bony interorbital space above. External nostrils rather high along front edge of snout, and a trifle further apart than width of bony interorbital space. Internasal space convex, and interorbital space, like most of head above, flattened. Skin smooth to touch. Under a lens everywhere shallow pits are seen and closely agglomerated granules, ends of glands, which may secrete a milky juice. Pores if present obsolete. Fore limb inserted about first $\frac{2}{15}$ in length of body, reaches half way to origin of hind limb, and moderately developed. Digits narrow, linear, lengthened, depressed basally and otherwise more or less cylindrical with slight bulbs at tips which are not disk-like. Also no webs or keels to digits. Third finger longest, about $3\frac{1}{2}$ in rest of arm, first shortest, and fourth a little shorter or subequal with second. Hind limb inserted about first third in length of body, and reaches 5 times in space to tip of tail. Third toe longest, 3 in rest of leg, first shortest, second shorter than fifth, which is shorter than fourth. Soles of feet without tubercles. Vent a short longitudinal slit close behind insertion of hind legs. Color in alcohol pale clay-brown, lower surface its entire extent lighter than upper. Back and sides irregularly sprinkled with clear well-defined black spots resembling grains of rather coarse gunpowder. Along side of body they are more thickly crowded, and along sides of tail become more

or less confluent to form more or less short vertical streaks, mostly convex forwards. Along sides of trunk and neck, upper series of spots longitudinally is distinctly made up of larger ones. Median line of tail below, belly, lower surfaces of limbs, throat, chin, snout and top of head above, immaculate. Upper surfaces of limbs covered with many small black spots. Iris slaty, pupil pale. Length $4\frac{3}{4}$ inches. This example secured in 1894, by E. D. Cope, at Atlantic City.

Also 2 smaller examples from White Pond in Warren County from Samuel N. Rhoads. This species is not so plentiful as the preceding. It is said not to be very active in its habits, occurring mostly in rocky ground, in fissures, and caves in cliffs. It is a species, perhaps more than any of our others to be associated with such places.

Salamandra longicauda Green, Journ. Acad. Nat. Sci. Phila., I, pt 1, 1818, p. 351.—Holbrook, N. Am. Herp., III, 1838, p. 111, Pl. 26.—Holbrook, l. c., Ed. 2, V, 1842, p. 61, Pl. 19.

Salamandra longicaudata Harlan, Journ. Acad. Nat. Sci. Phila., V, pt. 2, 1827, p. 331.—Harlan, Med. Phys. Res., 1835, p. 96.

Spelerpes longicauda Hallowell, Journ. Acad. Nat. Sci. Phila., (2) III, 1855-58 (January, 1858), p. 345.—Abbott, Geol. N. J., 1868, p. 803.—Stone, Am. Nat., XL, 1906, p. 161.

Spelerpes longicaudus Cope, Proc. Acad. Nat. Sci. Phila., 1867, p. 107 (ref. infers).

***Spelerpes ruber* (Daudin).**

PLATE 14.

Red Salamander. Red Lizard. Red Triton. Spring Lizard.

Head $6\frac{2}{3}$; depth $8\frac{3}{4}$; width of head $1\frac{3}{4}$ in its length from tip of snout to gular fold; length of mouth 2; interorbital space, measured from eye-sockets, $4\frac{1}{2}$; width of mouth $1\frac{2}{3}$; fore limb $1\frac{1}{3}$; hind limb 1; tail, measured from just behind vent, $1\frac{3}{5}$ in rest of trunk with head. Body short, robust, mainly cylindrical, though somewhat depressed above and below. Body all smooth

and convex, without ridges. Body also presenting a somewhat swollen appearance, though without marked constrictions, except possibly a slight one at neck. Costal grooves 16, first at axilla obsolete but it and inguinal also counted. Pelvic region with about 4 grooves more or less distinct. About a dozen grooves on anterior or basal sides of tail distinct, most posterior however becoming obsolete. No scapular groove. Gular fold well developed and sloping somewhat forward on neck below. Costal grooves while encroaching a little on sides of back do not extend far but leave a rather broad smooth area. Down middle of back from between shoulders to pelvic region a longitudinal groove. Belly and lower surface smooth, costal grooves only encroaching a little on sides, and gular fold extending all way across neck below. Trunk passes insensibly into rather short robust tail which is nearly square or quadrate at base,



Red Salamander. *Spelerpes ruber* (Daudin).

though corners rounded, and becomes more and more compressed towards rapidly attenuated pointed tip. Upper edge of tail keeled most of its length to tip, and lower edge rounded or convex till within about $\frac{1}{3}$ of tip. Thus in transverse section for nearly $\frac{2}{3}$ of its length anteriorly it is ovoid with bulge below. Head depressed, of about equal width with greatest width of trunk, triangular almost to being cuneate, and especially so laterally where angle of profile would form above. Greatest width of head posterior to eye. Snout about twice as broad as long, projecting much beyond closed mandible, and more or less bevelled all around. Eye a little elongate, ellipsoid, directed antero-laterally so that lines of upper eyelids would intersect before reaching tip of snout, rather small, and placed about

first third in head. Eyelids rather thin, ball of eye itself not much elevated. Mouth broad, gape straight, and when viewed below its profile more evenly convex than that of upper jaw. Lips hard and rather firm, upper with but a trifle of swelling on each side. A single series of nearly even small teeth around edge of each jaw. Palatine teeth in a transverse series, separated into a right and left patch, which is annectant at their approximation at each end of parasphenoid series so as to form an abrupt rectangle. Tongue a nearly circular disk, free, supported on a slender pedicel like a mushroom. Internal nares minute, placed close in front of middle of each transverse patch of palatine teeth, and each giving off a well-defined narrow groove extending out to margin of jaw externally. Distance between internal nares a little greater than bony space between eyes. External nostrils not very high along edge of snout and a trifle further apart than bony interorbital space. Internasal space convex and interorbital space flattened. Occipital region slightly convex. Skin lustrous and perfectly smooth. No indications of glands secreting a milky juice but skin everywhere beset with closely-set shallow pits. A circle of pores around eye extending anterior to those on side of head to nostrils, and more crowded. Lower edge of mandible encircled by a single series of pores, and 2 other nearly straight series start from point of chin and diverge backwards. Fore limb inserted near first seventh in body, reaches $\frac{1}{3}$ of space to hind limb, and rather short. Digits feeble, rather depressed, with convex surfaces, elongately triangular, and tips rounded, though not disk-like. No webs, tubercles or keels to digits. Third finger longest, about 4 in rest of arm, first shortest, and fourth a little shorter than third. Hind limb inserted nearer tip of tail than that of snout by space equal to about length of gape. Fourth toe longest or about $4\frac{1}{2}$ in rest of leg, first shortest, second and fifth subequal, and a little shorter than third. Vent close behind insertion of hind legs as a longitudinal slit. Color in alcohol brownish above and pale or dull creamy-brown below. Back mottled entirely with large well-defined slaty-dusky blotches or spots, some more or less confluent, though all larger and more conspicuous than elsewhere. In size they attain nearly that of eye-ball. On snout

and entire upper sides of body and tail spots become very small and inferiorly more or less punctate. Edges of jaws or lips with some dusky or brownish cloudings. Lower surface of head with a number of small brownish punctuations, and a very few scattered over belly. Limbs creamy-brown like belly below, and upper surfaces with dark spots, though smaller, like those on back. Feet pale. Iris slaty. Length $4\frac{5}{16}$ inches. This example from Camden County, obtained by Charles Liebeck.

This animal is perhaps the most brilliantly colored of all our salamanders, though varying from a nearly uniform grayish-brown to bright orange-red. Also there is great variation in the spots, some being large and blotched while in others they may be



Red Salamander. *Spelerpes ruber* (Daudin). (Variety.)

very finely punctate or altogether absent. Others have the back with a more or less livid purple tint, and the blackish or dark markings on the back are obscure. The young as a rule seem to have the colors much purer, and are generally all more or less orange. It is generally abundant though cannot be considered quite so numerous as either *Desmognathus fusca* or *Diemictylus viridescens*. Still on account of its more retiring habits, it may be frequently overlooked where either of the latter would be observed. It is usually found in the hilly or upland regions. It is seldom seen on the ground and then only after rains, as I have noted on a few occasions. It is, so far as I have observed, almost entirely aquatic, though sometimes may occur in damp fields or woods under wet logs or stones, but is chiefly character-

istic of springs and well-heads. The stones about some cold woodland spring are its special delight, and it is seldom one fails to find one or more in such places. Cope aptly states that "here, beneath stones, it may be always found, occupying, if possible, the fissure from which the limpid water rises, and displaying its beautiful hues through the transparent medium with the brilliancy of a strange exotic, rather than the pallor of a dweller in the chilly depths and dark recesses of a cave." When swimming they move with some activity, soon resting, and not being so restless as some of our other species. They undulate their tails from side to side and press the limbs to the sides of the body. They feed largely on insects and are perfectly harmless, seldom attempting to bite. Near Trenton Dr. Abbott says it is common about well-heads and is associated with *Spelerpes bislineatus*. He believes it is able to produce a slight peeping note though Cope thought this impossible on account of the structure of its throat. The usual specific denomination *ruber* cannot be set aside for this animal as it is not reasonably certain that the *Siren operculata* of Beauvois, which has priority, is the larval stage. Should it prove identical, however, the species must be known as *Spelerpes operculatus* (Beauvois).

Salamandra rubra Harlan, Journ. Acad. Nat. Sci. Phila., V, pt. 2, 1827, p. 332.—Holbrook, N. Am. Herp., IV, 1840, p. 123, Pl. 27 (ref. infers).

Pseudotriton ruber Abbott, Geol. N. J., 1868, p. 803.

Spelerpes ruber Cope, Proc. Acad. Nat. Sci. Phila., 1869 (May), p. 107 (ref. infers).—Abbott, Nat. Rambles, 1885, p. 477.—Cope, Bull. U. S. Nat. Mus., No. 34, 1889, p. 172, fig. 43, Pls. 92 fig. 2, 29 & 30 figs. 1-5, 31 figs. 1-5, 32 figs. 1-3, 35 figs. 7-10, 40 figs. 1-2, 45 fig. 6, and 48 fig. 16.—Sherwood, Proc. Linn. Soc. N. Y., 1894-95, No. 7, p. 30.—Stone, Am. Nat., XL, 1906, p. 162.

Spelerpes ruber ruber Cope, l. c., p. 181.

? *Siren operculata* Beauvois, Tr. Amer. Philos. Soc. Phila., IV, 1799, p. 81, Pl., fig. 3.

Salamandra maculata Green, Journ. Acad. Nat. Sci. Phila., I, pt. 2, 1818, p. 350.—Harlan, Journ. Acad. Nat. Sci. Phila., V, pt. 2, 1827, p. 331.—Harlan, Med. Phys. Res., 1835, p. 96.

Salamandra subfusca Green, l. c., p. 351.—Harlan, Journ. Acad. Nat. Sci. Phila., V, pt. 2, 1827, p. 331.—Harlan, Med. Phys. Res., 1835, p. 96.

Salamandra rubriventris Green, l. c., p. 353.—Harlan, Med. Phys. Res., 1835, p. 97.

Proteus neo cæsariensis Green, l. c., p. 358.—Harlan, Med. Phys. Res., 1835, p. 165.

Family DESMOGNATHIDÆ.

The Dusky Salamanders.

Pterygoids wanting. Otbitosphenoid separated by membrane from proötic. Vestibule, internal wall osseous. Dentigerous plates on parasphenoid. Ceratohyal articulating with quadrate. Carpus and tarsus cartilaginous. Vertebrae opisthocœlous. Hyoid apparatus as in *Plethodontidæ*.

A single genus with several species, mostly aquatic.

Genus DESMOGNATHUS Baird.

The Dusky Salamanders.

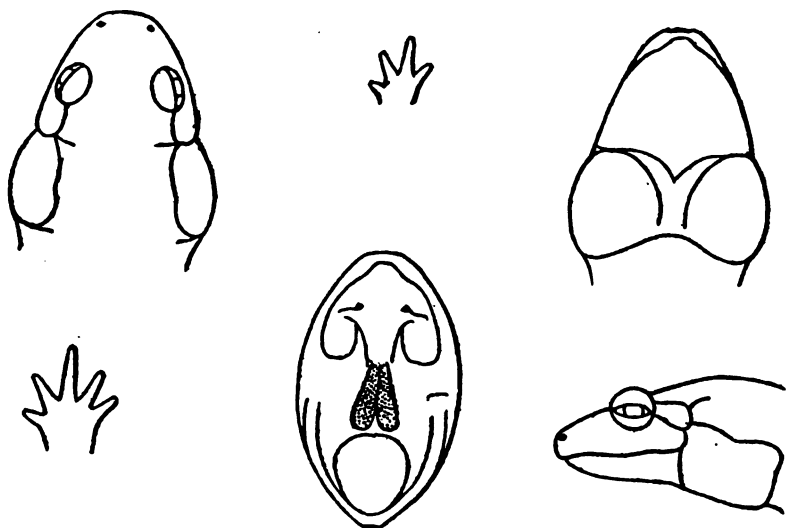
Desmognathus fusca (Rafinesque).

PLATE 15.

Dusky Salamander. Black Water Lizard. Yellow Salamander.
Brown Newt.

Head $7\frac{2}{3}$; depth $11\frac{1}{3}$; width of head $1\frac{1}{2}$ in its length from tip of snout to gular fold; length of mouth 2; interorbital space, measured from eye-sockets, 5; width of mouth $1\frac{4}{5}$; fore limb $1\frac{1}{4}$; hind limb 1; tail, measured from just behind vent, less than rest of body by length of snout. Body rather robust, stout, generally cylindrical, though somewhat depressed above and below. Edges of body all convexly rounded and smooth, without ridges. Also body more or less swollen in appearance, with-

out marked constriction except behind gular fold at neck. Costal grooves 14, counting axillary, and also an obsolete fifteenth may be seen at groin. About 4 very obsolete pelvic grooves. About a dozen or more grooves along side of tail, becoming obsolete and fading out towards its tip. No scapular groove. Gular fold very well developed, and sloping a little forward. Lateral grooves not encroaching much on sides of back very deeply, like on sides, though their courses obsoletely evident more or less across, both above and below. Down middle of back, from nape to tail, a median groove. Belly and lower surface



Dusky Salamander. *Desmognathus fusca* (Rafinesque).

smooth. Gular fold extending as a slightly blunt angle across throat. Trunk passes without constriction or swelling into rather short robust tail which is quadrate, or nearly square at base, though corners rounded, and becoming more compressed towards rapidly attenuated slender tip. Upper edge of tail with a well-developed keel most all its length, and lower surface with a median longitudinal groove from after vent for about $\frac{2}{3}$ its length. In transverse section tail would be seen to be largely ovoid, at least for greater anterior portion, and with bulge below. Head wide, equal in width at least to greatest width of

body, swollen in appearance, depressed both above and below, cuneate as viewed above, and surface convex. Profile rather elongate, rounded, and angle would form about midway in its depth. Snout large, depressed, its length about half its width, and projecting beyond mandible when closed. Eye small, a little long or ellipsoid, directed antero-laterally and lines of upper eyelids convex so as not to intersect before reaching tip of snout. Eyelids moderately developed, and rather prominent. Mouth rather more constricted in convex profile than edge of jaw when viewed from below. Gape slightly undulated. Lips rather hard and firm, and edges when closed presenting a rather even convex surface inferiorly. A single series of small, firm and more or less even teeth in each jaw. No palatine teeth, though a \wedge -shaped patch of fine ones posteriorly on parasphenoid. Tongue ovoid, moderately large, with tip directed anteriorly, surface finely papillose, edges free and thin. Internal nares as 2 oblique short slits anteriorly approximated, and each giving off an external groove towards edge of jaw. Space between internal nares about equal to bony interorbital space. External nostrils a little high along edge of snout, each sending down a groove to edge of lip, and separated by a space a trifle more than that between eyes measured over bony area. Internasal space convex, and interorbital space flattened. Upper surface of head posterior to eyes with swollen convex appearance. Skin all finely or minutely pitted with minute granules, also all mixed in. Pores around eye more or less obsolete. Fore limb inserted about first sixth in body, reaches about a third of space to insertion of hind limb, and rather weak. Digits rather slender, depressed, edges rounded, not webbed, and with bulbous tips which are not disk-like. No tubercles on hands or feet. Third finger longest, $3\frac{1}{2}$ in rest of arm, first shortest, and second and fourth subequal. Hind limb inserted a little nearer tip of snout than tip of tail, reaching $3\frac{1}{2}$ to tip of latter, and rather robust. Fourth toe longest, about 3 in rest of leg, first shortest, third a little shorter, fourth and fifth shorter than third, though a trifle longer than second. Vent a longitudinal slit on lower surface of trunk just after hind legs. Color in alcohol deep dusky or blackish-brown, with a somewhat

olive shade. Sides similarly blackish. Lower surface, including all of head below, belly and most of tail basally, soiled pale brown, soilings dusky or smutty-brown, and scattered over entire surface. In fact, greater part of tail, or outer $\frac{3}{4}$ nearly, smutty-brown entirely on under surface. Lips brownish. Interorbital space brownish. Feet, hands and limbs dusky-brown above, below paler and soiled like belly. Iris slaty. Length $3\frac{9}{16}$ inches. Described from an example obtained along Big Timber Creek near Clement's Bridge, in Camden County, by Mr. J. A. G. Rehn.

Very many others were examined from Morris County (C. Fisher), and Trenton (Dr. C. C. Abbott). Mr. Samuel N. Rhoads has also found it at Swartzwood Lake in Warren County. Mr. H. L. Viereck has taken it at the above mentioned locality along Big Timber Creek. Mr. T. D. Keim, Dr. C. C. Abbott and myself found it under stones in the beds of affluents to Kinkora Creek, and southeast of Bordentown, during the past October. The largest adult seen in the water was dull brown speckled with darker on the back. Small larvæ were also seen in the water. Very great range in color-pattern and color-variation may be noted in this species. Young an inch long have the pale area on the back more or less immaculate pink or pale brown. The uppermost of the accompanying figures indicates this type. They vary from these shades into the dusky-black adults. Also they do not always appear to change from pinkish to brown, as some with pink backs are found equally as large as the larger brownish ones. The pale colors of the back are also not always immaculate, many being variously blotched or speckled with darker or brownish. Very dark or blackish examples, not larger than the largest pink or brown ones also occur, though these all show traces to some extent of the dorsal color-patterns. Most all full-grown examples lose every trace of the dorsal color-pattern in the blackish of the back. Perhaps the most abundant in individuals among cold-blooded vertebrates in some localities is this little salamander. In the upland it is found nearly everywhere in the valleys, about and in streams, and on the comparatively dry mountain-tops, though less numerous and more solitary

about the latter. About the headwaters of some streams they are even more abundant, and sometimes one may there have the opportunity of examining multitudes of living examples. So abundant are they in some localities that as many as 4 or 5 will frequently occur under a single small stone. Where brooks are swift, cold and sinking out of sight in some places, to appear again in others, very favorable habitats are secured in the comparatively damp intercourses which are only flooded in time of heavy rains. They prefer shallow streams which are rapid, and not the stiller or deeper waters. The delicate larvæ, however, occur most everywhere, and are frequently taken in mud and rank aquatic vegetation. The eggs are said to be connected by an albuminous thread on emission, which soon contracts and hardens. Then one of the sexes wraps this rosary around the body several times, and remains in a comparatively dry spot for protection. The adult animals are among our most vigorous and active species, soon scampering or wriggling out of sight from an upturned stone. Then again they may remain until probed or touched in some way, suddenly wriggling away. They are soon enabled to burrow in the ground, or among little stones, crevices, etc., by means of their strong muscular development. It is the most abundant species around Trenton, according to Dr. Abbott, especially under stones in the water, water-logged foliage, etc. As small and medium-sized examples greatly resemble *Plethodon erythronotus*, which is rather abundant in the dry upland woods, a good character for distinguishing the 2 species at a glance will be found in the pale or whitish streak extending down from the eye behind. This is present on most all examples and may frequently be traced to some extent in the blackish adults. It may also be distinguished from *Spelerpes bislineatus* in the same way. I have quite recently pointed out the supposed identity of the nominal species *Desmognathus ochrophava* Cope, and *Salamandra haldemani* Holbrook, with this species. Dr. Stejneger has, however, shown that *Salamandra quadrimaculata* Holbrook is not identical, as supposed by Cope.

Salamandra fusca Green, Journ. Acad. Nat. Sci. Phila., I, pt. 2, 1818, p. 356.—Harlan, Journ. Acad. Nat. Sci. Phila., V, pt. 2, 1827, p. 330.—Harlan, Med. Phys. Res., 1835, p. 96.

Desmognathus fusca Abbott, Geol. N. J., 1868, p. 803.—Cope, Proc. Acad. Nat. Sci. Phila., 1869, p. 115.—Abbott, Nat. Rambles, 1885, p. 476.—Cope, Bull. U. S. Nat. Mus., No. 34, 1889, p. 194, Pls. 34 figs. 5-6, 36 fig. 1, 45 fig. 7.—Sherwood, Proc. Linn. Soc. N. Y., 1894-95, No. 7, p. 33.—G. M. Allen, Proc. Bost. Soc. Nat. Hist., XXIX, 1901, p. 73.—Stone, Am. Nat., XL, 1906, p. 162.

Desmognathus fusca fusca Cope, l. c., p. 195, fig. 48.

? *Desmognathus ocrophea* Sherwood, l. c.

Family PLEURODELIDÆ.

The Newts.

No ethmoid bone. Vomeropalatine bones with separate posterior processes extending over parasphenoid and having teeth on their inner margins. Prefrontals and pterygoids present. Parietals not embracing broad frontals. No dentigerous plates on parasphenoid bone. An osseous postfronto-squamosal arch. Ceratohyal free, connected with quadrate by ligament. Carpus and tarsus osseous. Vertebrae opisthocœlous. No otoglossal cartilage.

All of the genera are represented in the Old World, but 2 species of the genus *Diemictylus* occurring in North America.

Genus DIEMICTYLUS Rafinesque.

The Newts.

Diemictylus viridescens (Rafinesque).

PLATES 16 (aquatic form) AND 17 (red land form).

Newt. Red Eft. Red Lizard. Water Lizard. Spotted Triton.
Small Red Lizard. Yellow Bellied Lizard.
Red Evet. Water Newt.

Head $6\frac{1}{2}$; depth about 10; width of head about $1\frac{3}{5}$ in its length from end of snout to constriction of neck; length of mouth

or gape about $1\frac{5}{6}$; bony interorbital space about 4; width of mouth $1\frac{2}{3}$; fore limb about 5 in head and trunk; hind limb about 5; tail about $1\frac{1}{6}$ in head and trunk together. Body robust, elongated moderately, slightly depressed below anteriorly, and rounded or constricted convexly above. Surface all rounded, without sharp ridges, largely smoothly convex. Trunk a little swollen, depressed below, and somewhat more constricted in convexity above. No costal grooves. A well-developed median dorsal keel from occiput to tail, and after its root much broader all around edge of latter, extending forward below till just after vent. In transverse section trunk would be oval with bulge below. No keel along each side of back. Tail greatly compressed throughout, though in transverse section narrowly ellipsoid. This, however, becomes obscure gradually, posteriorly. Head moderately large, a little broader than greatest width of



Newt. *Diemictylus viridescens* (Rafinesque). (Red form.)

body, depressed both below and above, though latter slightly convex. When viewed from above profile seen as rather evenly oval, contracting anteriorly and posteriorly, though not distinguished from neck by abrupt contraction of latter. Upper profile rather blunt, rounded, with angle falling about opposite eye, or superior in depth of head. Snout about $\frac{3}{5}$ as long as broad, and projects well beyond closed mandible. Snout when viewed from above truncate-rounded. Eye elongate, moderately small, and placed about first $\frac{2}{5}$ in head. Eyelids fleshy, rather thick and not very distinct from rest of head, and as eyes are lateral and not projecting upward they are nearly plane with front. Pupil circular. Mouth large, broad, and when viewed from below seen to be in a little more evenly convex than blunt profile of snout or upper jaw. Lips rather firm, and lower only partly

overlapped by posterior part of upper. No distinct lower lip or groove. No gular groove or postrictal grooves. Parotid region not swollen. A series of small teeth in jaws. Vomerine or palatine teeth as a double series longitudinally, converging anteriorly, and joining after running close together between internal nares. In size these teeth minute like those in jaws. Tongue small, slightly free along sides, but not at posterior and anterior ends, and surface finely papillose. Internal nares about as far apart as bony interorbital space, and each with an outer groove towards edge of jaw. Exterior nostrils perhaps a trifle closer together than interior nares, and rather high on each side of snout in front. Internasal space convex and interorbital largely flattened or level. On top of head 2 ridges enclosing a long lenticular open groove closed in front on muzzle and rather open behind at occiput. On each side of these ridges a shallow groove. Loreal region slightly concave. Canthus rostralis distinct. Skin roughened with numerous semitransparent horny points on upper surface of body, and lower surface smooth. On side of head behind eye a series backwards of 4 pits. First near eye and last in position of first branchial fissure. In form pits shortly linear and curved as if made by an instrument with a short curved edge. Distances between equal, or about same as eye-diameter, though first much closer to eye than its own length. Fore limb inserted about first $\frac{2}{11}$ in body, and when pressed back reaches $\frac{3}{4}$ of space to hind limb. Digits narrowly triangular, pointed, not swollen at tips, depressed, and with very slight membrane between toes. Third finger longest, 3 in rest of arm, first shortest, and fourth shorter than second. Hind limb inserted first $\frac{3}{7}$ in body, robust, and when pressed back reaches $\frac{2}{3}$ to tip of tail. Third toe longest, fourth but little shorter than third, second shorter than third, first shortest, and fifth but little longer than first. Vent as a callosity directly after hind legs, and region about it swollen. Color in alcohol rich pale brown above, paler or light on lower surface, this latter also including some of limbs. Back, tail and limbs above finely though rather sparsely dotted with jet-black. A series of about 3 or 4 spots down side of back, with an annectant small whitish or yellowish dot

of similar size. No spots on head above, a few on throat, breast and belly. Iris slaty. Length $2\frac{9}{16}$ inches. Described from an example obtained at Swartzwood Lake, in Warren County, during October of 1895, by Samuel N. Rhoads.

Also a number of smaller ones with the same data. I have examined Green's examples of the *miniatus* stage, and they may have been taken within our limits. This is our most abundant aquatic salamander in the upland ponds, lakes and other still waters. In some places they occur in great numbers all about the shallows. Again, I have found them equally abundant in deep places. They will also frequent the vicinity of any small carcass, such as suitable places where fishermen may throw over the viscera, heads, fins, etc., of their catch. They do not seem well adapted, usually, as a bait for pike, according to some fishermen. Sometimes examples may be seen with a limb, or portion of the tail, etc., injured, probably due to the rapacity



Newt. *Diemictylus viridescens* (Rafinesque). (Aquatic form.)

of some fish. When one is fishing these animals will sometimes nibble the worms or bait, and while not taking it, will hold fast till lifted ashore. In some places they are so numerous as to prevent one taking minnows for bait. By the ignorant they are sometimes regarded as poisonous, and, therefore, not molested. With a small dip-net several may be taken in a single scoop. Occasionally they float lazily up to the surface of the water, but usually may be seen wending their bodies slowly along, either in open spaces or among grass. Again, they will remain exposed, their bodies contrasting for a long time with their surroundings. Sometimes they will dart suddenly, rapidly undulating the broad tail, though at any time never difficult to capture, especially as they are not shy. They usually make no effort to secrete themselves when first pursued, though when frequently disturbed will hide

under stones, water-logged branches, twigs and water-soaked bark. In color, those approaching the larval form are dullest, grayish on the back and light gray on the belly. The larger and more rotund forms, probably gravid females, have the more brilliant markings, brown on the back with brilliant carmine spots, and canary-yellow on the belly, with clearly defined dark brown or black spots. The males have some color-markings on the back, but are orange-yellow on the belly. Some are cinnamon-red and flesh-colored, the mottlings not showing very distinctly. The forms under stones near the shore are sometimes brighter red than those taken from the moss and lichens on shore. The dark spots on the belly vary greatly in individuals, some having them abundant and crowded, while in others they are more sparsely distributed. They also vary in size, sometimes being quite large, but then less numerous. All yellow-bellied examples are usually spotted with brownish or blackish. The reddish spots on the back are not always present, and they vary similarly. Sometimes the markings on the tail are blotches, and at others they are confluent into longitudinal streaks. The latter being usually associated with the absence of crimson spots on the back. The red water-forms are usually much more shy and agile, also more difficult to capture, while the red land-forms are inert under the stones and moss, where the temperature is about 50° F. Red land-forms are usually sparsely marked with blackish points on the belly and decidedly less so than the red water-forms. When captured they make little resistance, and float or swim comfortably about if dropped into a vessel of water. They feed on flies, and in fact any small insect dropped on the surface. When seizing their prey they move slowly through the water towards it, and suddenly snap at it. If not successful they do not again resume operations until another opportunity is offered, when the same performance is repeated. Their method is always slow and deliberate, and sometimes they may seize and snap one another, apparently by mistake. If their prey is too large they usually persist a long time till they are able to swallow it. The fin-like tail is developed in the male during the spring, and a ridge also extends along the middle of the back.

He may also be further distinguished by the blackish swellings on the thighs and feet, which are very conspicuous. The male is enabled by these means to retain his hold on the female, grasping her around the neck with his hind legs. They will remain fastened together some hours, during which time he jerks her about and discharges the seminal fluid. This is said to be diffused in the water and fecundate the ova while still in the lower part of the oviduct. Then the eggs are laid singly. They are ellipsoid in shape, covered with a mucous or sticky coat which is attached, usually to the middle of an immersed leaf, which is then doubled over it by the exertions of the female. After remaining this way some time they finally give birth to small larvæ. I have not found the eggs, however, myself, though seen the preliminary courting operations. The *miniatus* form of this animal has been found, according to some observers, to be nothing more than a terrestrial condition. It is claimed that when placed in confinement with other salamanders, where they could resort to the water if they wished, they remained some days hiding under wet moss and stones, but finally crept out at night and went into the water. They readily devoured insects and worms. In about 3 months they are said to have lost their bright red, and in less than a year were the usual *viridescens* olive. It is also claimed for some *viridescens* examples 2 years old taken from ponds and put in earth and dead wet leaves without water, that they began to loose their green tint and assume a dingy brownish. I have never experimented for these changes myself. The red form is frequently seen, and in such as I have seen so far, is usually bright colored. They may be frequently seen at times, even when not rainy, in woodland on stones, logs, bark, or leaves, etc., but never apparently so numerous as the aquatic form. The latter has a voice, more of a harsh or grating weak little squeak, though I have never heard the red ones utter it. I shall, however, leave the identity of the two forms to future investigation. Dr. Abbott found it in the Delaware among *Vallisneria* near Trenton, and in eel-grass, when taken in fish-nets. He has also found it in clear grassy waters tributary to Crosswicks Creek.

Notophthalmus viridescens Abbott, Geol. N. J., 1868, p. 803.

Diemyctylus viridescens Abbott, Nat. Rambles, 1885, p. 476.—
Cope, Bull. U. S. Nat. Mus., No. 34, 1889, p. 207, Pls. 36 figs.
3-4, 40 figs. 5-9, 41 figs. 3-4, 42 fig. 3, 45 fig. 9, 49 fig. 4.—
Sherwood, Proc. Linn. Soc. N. Y., 1894-95, No. 7, p. 35.

Diemyctylus viridescens viridescens Cope, l. c.

Notophthalmus miniatus Abbott, Geol. N. J., 1868, p. 803.

Order SALIENTIA.

The Leaping Amphibians.

Body short, broad, and tail not present when adult. Usually no teeth in lower jaw. Young fish-like, or as a tadpole, with broad head, long tail, external gills and without limbs or teeth. They feed on vegetable matter and thus have very long intestines. By degrees they develop into the adult, which is more or less frog-like. The adult with 4 limbs, posterior pair long, strong and developed for leaping.

This order, comprising the frogs and toads, reaches its greatest development in tropical America. Fossil remains occur as early as the Jura.

Key to the families.

- a. ARCIFERA. Thoracic region expansive, free and divergent ends of coracoid and precoracoid connected by 2 cartilaginous longitudinal bands, cartilage of 1 side overlapping other.
 - b. Upper jaw toothless. BUFONIDÆ
 - bb. Upper jaw toothed.
 - c. Digits tapering, without viscid disks; a flat-edged spur at heel; parotids present; subterranean. PELOBATIDÆ
 - cc. Digits usually dilated at tips to form viscid disks; no spur; no parotids; mostly arboreal. HYLIDÆ
- aa. FERMISTERNIA. Thoracic region not expansive, 2 bands of cartilage united in median mass between adjacent ends of nearly parallel coracoid and precoracoid. RANIDÆ

Family BUFONIDÆ.

The Toads.

Jaws toothless. Vertebrae procœlous, without ribs, sacral more or less dilated. Fingers and toes free or webbed, and with

tips sometimes dilated into regular disks. Sternum usually a cartilaginous plate, and sometimes ossified along its center, or with a well-ossified style. Pupil occasionally erect. Tongue mostly elliptic and entire.

A rather large family represented by a single genus within our limits.

Genus BUFO Laurenti.

The True Toads.

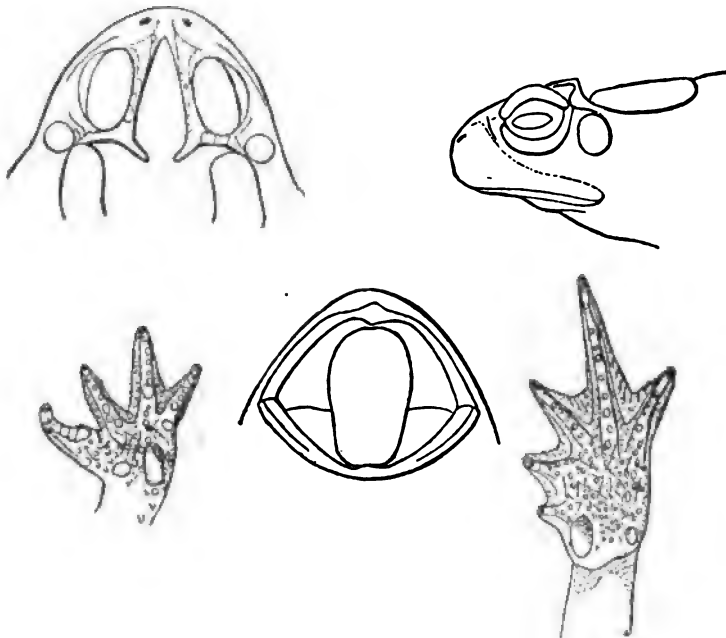
Bufo lentiginosus (Shaw).

PLATE 18.

Toad. Hop Toad. Common Toad.

Head, measured to posterior edge of tympanum, $3\frac{3}{4}$ in body to end of trunk, not including hind limbs; depth $2\frac{2}{3}$ normal; greatest width of body $1\frac{3}{4}$; width of head at posterior margins of tympani greater than its length by horizontal diameter of eye; snout $2\frac{4}{5}$; eye 3; mouth $1\frac{1}{15}$; interorbital space, measured from eye-sockets, $4\frac{1}{3}$; fore limb $2\frac{1}{6}$ in head and trunk; hind limb when outstretched greater than head and trunk by horizontal eye-diameter. Body robust, depressed, more or less swollen in appearance, when viewed above ovoid with bulge at pelvic processes and then slightly constricted back. Surface rather well depressed both above and below, only slightly convex. Pelvic bones forming but a very slight obtuse angle in profile along back, but little behind middle of length of head and trunk, or about $\frac{4}{7}$ of space, though processes obsolete. Head moderately small, broad and depressed, both above and below. Snout short, bluntly convex, its length a little less than half its width, and when viewed above rather evenly convex. Eye rather large, a little longer than deep, its posterior margin nearly midway between tip of snout and shoulder, or about over middle in gape of mouth. Mouth large, gape but slightly convex in profile, with convexity superior. Lips thin, firm or rather horny,

with upper overlapping edge of mandible when mouth closes. Lower lip firm, though rather thick. When viewed below mouth broadly convex, with more constricted convexity of upper jaw projecting in front. Front of upper jaw when viewed in front with a slight emargination medianly into which a corresponding low process of mandible at symphysis fits, and labial edge on each side of latter slightly and shortly emarginate. Teeth none, edge of jaws or lips firm, and acting as a tough cutting edge. Tongue



Toad. *Bufo lentiginosus* (Shaw).

large, fleshy, surface finely papillose, only attached in front, behind and sides entirely free. Internal nares more or less concealed by superior buccal fold, placed a little further apart than external nostrils, and rather large. External nostrils rather large, a little high on front side of blunt snout, falling a little nearer eye than emargination in middle of front of upper jaw. Internasal space nearly level, and a little greater than bony interorbital space, or about half of eye-ball. Interorbital space narrow over bony area, with concave surface and ridges on each side

separating eye-sockets. Loreal region deep, bevelled or slightly concave on surface. Tympanum close behind orbit, also a trifle below, a little deeper than wide, and its width about $\frac{2}{3}$ in length of eye. Skin pustular over entire surface, and on lower surface of limbs and around postfemoral region forming small tubercles. Parotids large, elongate, varying little in breadth, and width about $\frac{2}{3}$ their length. Fore limb inserted a little before first third in length of head and trunk, robust, and reaches back well beyond insertion of hind limb. Fingers 4, large, slender, not webbed, depressed above somewhat basally, each rounded, with a tubercle at each joint below and a pair of larger ones on palm. First and third fingers longest and subequal, about 3 in rest of arm to shoulder. Second finger a little shorter, and fourth shortest. Hind limb not strong, but moderately robust, femoral region shorter than tibial, and space between tip of fourth toe and heel but a little greater than rest of limb measured to groin, though about $1\frac{1}{2}$ when measured to vent. Fourth toe longest, others all graduated down shorter, first shortest, and fifth a little longer than second, or shorter than third. Hind toes all slightly webbed at bases, membrane rather thick. Phalanges with rather well-developed tubercles on lower surfaces at articulations. Two well-developed tubercles on sole of hind foot, inner larger and with blackened horny sheath. Color in alcohol blackish-brown above, with a number of deep black maculations of various sizes separated by a pale brown median vertebral streak from interorbital space to vent. Several creamy-brown streaks extend obliquely back from parotid on sides. Latter and femoral region finely mottled or speckled with creamy-brown. Below dirty creamy-brown, breast, chin, lips and throat, finely speckled with blackish markings, varying in size and shape. A dusky blotch below eye separated on each side by a pale brownish streak extending from lower front and posterior margins of eye, former down to upper lip and latter to gape of mouth. Iris slaty. Length $5\frac{1}{4}$ inches. This example obtained by Messrs. J. A. G. Rehn and Witmer Stone, near the head of the Batsto River, in Burlington County, August 13th, 1902.

Color of adult male in life. Above olivaceous-brown, darker on dorsal region, and becoming paler on sides. Upper surfaces of

limbs olivaceous. Excrescences on back with more or less brown tints. Several large blackish-brown blotches on back, slightly ocellated narrowly with light or dull olive-yellow. Some tubercles on side of head and upper surface of limbs tinted with brownish. Upper surfaces of limbs and side of body with irregular dusky-brown to blackish streaks, spots or blotches. Along edges of limbs when viewed below these specks produce fine mottled appearance. Lower surface of body chiefly dull buff, chest with pale dusky specks here and there. Throat tinted brownish. Buff of lower surface only extending a little upon sides, which have an infusion of pale olivaceous. Feet brownish on soles, tubercles on sole of fore feet pale brownish, and on that of hind feet blackish. Tips of hind toes dusky or blackish. Tympanum brown. Iris brownish with beautiful coppery and golden reflections. Length $5\frac{3}{4}$ inches.

Color of adult female in life. Above of a warm or maroon-brown, darker on dorsal region and fading paler laterally. Upper surfaces of limbs of usual tint of back, also with some infusion of olivaceous; and in case of posterior largely with dusky, even blackish. Tubercles all more or less brownish, of warm or maroon tint. Several large indistinct blackish or dusky blotches slightly ocellated with pale narrow edges on back. Sides and upper surfaces of limbs spotted with dusky or blackish, most distinctly on costal region. A paler diffuse brownish shade than color of back, extending in groin towards anus, offsetting dark color of legs above. Lower surface of body dull buff, and this shade also on inferior surfaces of limbs. Toes and soles of fore feet brown, tips of thumbs but little darker. Soles, spurs and tips of toes of hind feet blackish. Tubercles on fore feet brown. Throat brown. Several pale brown spots on breast. In other respects colored more or less similar to male. Length $7\frac{1}{2}$ inches.

About Trenton, according to Dr. Abbott, they do not appear to be as common as formerly. They are abundant along the Delaware River banks and have been heard roaring as late as the 14th of June, though in other localities I find they frequently will continue till August and September at times. They are

among the most beneficial animals to man on account of the large number of insects which they destroy. Although the toad has been greatly discredited on account of its ugliness by most persons, the eye of this animal, on the other hand, has been thought from time immemorial an object of beauty. The public sentiment in the case of the toad is, perhaps, greater than that of any other of its relatives, and it is rarely if ever killed, except with regret. The urchin who pelts frogs will seldom molest the toad. This, however, may not altogether be due to the superstition that handling an individual will produce warts, or the more or less nocturnal habits of the animal, but to some appreciation of its value as an insect-destroyer. By the middle of spring they begin to utter their call-notes, which are kept up during most all of our warm weather, though seldom in the daylight. The eggs are laid in long strings and are familiar to most everyone. By early June most of them are hatched and scores, in some places hundreds, of the jet-black little tadpoles may be seen mostly quiet in some shallow pool. By the end of the month these will have changed to toads and be found far up on the hills, skipping about mostly over the more or less clear spaces. During early and midsummer toads seem more noisy just after a rain at night. Sometimes their concert is prolonged and varied by the additional interpolated rattlings of *Hyla versicolor*, who will descend to low bushes, or along fences, and join in the chorus, probably under the incentive of the increased moisture. Usually in April, or just as soon as they have finished their winter hibernating, they repair to some shallow, quiet pool or pond. Frequently many of them may be found all about in the shallower places, as they do not swim very deep. Many such places are more or less choked up with vegetation, etc., so that the water is clear and still. The continual rolling call of the male toad may be heard for quite a distance, and as he utters it, sits mostly exposed or out of the water, though usually perfectly quiet, except for the slight movement of his throat in pumping air into his lungs. Suddenly his throat is greatly inflated and the long even hoarse call is emitted. It usually lasts for about 15 or 20 seconds, stopping suddenly. Its quality is of even tona-

tion, without crescendo or decrescendo effects, and at a distance suggests something of a far-off tug-boat whistle. The throat, or vocal vesicle, is inflated till about equal to the head in size. The toad varies somewhat in color in individuals, appearing quite dark in some and paler in others, though the former is always the case when not inflated owing to the effect of light. When a female happens to approach one of these singing males he will immediately hop through the water several times till he succeeds in reaching her, and in doing so usually causes quite a little commotion by splashing about. Then he jumps upon her back to dig his thumbs in her axillaries and there remain. I have not seen them make a call when embraced, and if one attempts to lift the male off he will still retain his hold so that both may be lifted up simply by securing the male. When captured in this manner they will only produce a squeak occasionally. Sometimes a number of more unfortunate males who are unable to procure females will make a concerted move upon one should she approach near. The female may frequently be seen swimming beneath the water with her lord taking an easy ride. To some extent they appear to harmonize well in color with their surroundings. Sometimes late in summer, and even into October, the males may be heard occasionally giving vent to their call. Mr. S. H. Hamilton reports a normal sized jet-black example from Beamersville, in Sussex County. It was taken among rocks of the eleörite syenite class, which were weathered very black, and possibly the individual in question is an instance of the change in color or pigment due to the environment. Messrs. Witmer Stone, H. L. Coggins and J. A. G. Rehn found this species about the head of the Batsto River in 1901, and on their trip from Bear Swamp to the "plains" in 1902. Dr. H. A. Pilsbry secured examples at Cape May, where I have also observed it.

Bufo lentiginosus Abbott, Nat. Rambles, 1885, p. 476.—Cope, Bull. U. S. Nat. Mus., No. 34, 1889, p. 277.

Bufo lentiginosus americanus Cope, l. c., p. 284.—Sherwood, Proc. Linn. Soc. N. Y., 1897-98, No. 10, p. 17.—Stone, Am Nat., XL, 1906, p. 162.

Bufo musicus Harlan, Journ. Acad. Nat. Sci. Phila., V, pt. 2, 1827, p. 344.—Harlan, Med. Phys. Res., 1835, p. 109.

Bufo americanus Holbrook, N. Am. Herp., I, 1836, p. 75, Pl. 9 (ref. infers).—Holbrook, l. c., Ed. 2, V, 1842, p. 17, Pl. 4.—Abbott, Geol. N. J., 1868, p. 805.

Family PELOBATIDÆ.

The Burrowing Toads.

Upper jaw toothed. Vertebrae mostly procelous, without ribs, sacral strongly dilated. Fingers and toes free or webbed, without disks and simple. Sternum a cartilaginous plate or a bony style, with cartilaginous disk. Pupil erect. Tongue rounded, nearly entire.

A rather small family of stout toad-like appearance and habit, mainly nocturnal, and burrowing in the ground by means of the spur-like heel of the hind limbs. Also the vertical cat-like pupil is an adaptation for this habit, or peculiarity not usually exhibited by toads which are more or less crepuscular. A single genus within our limits.

Genus SCAPHIOPUS Holbrook.

The Spade Foot Toads.

Scaphiopus holbrookii (Harlan).*

PLATE 19.

Spade Foot Toad. Spade Foot. Hermit Toad. Hermit Spade Foot Toad.

Head, measured to posterior edge of tympanum, 3 in body to end of trunk, not including hind limbs; depth, a little swollen,

* I give the following notes on an example which I received from Mr. James A. G. Rehn, during August of 1905. As it was brought alive from Palatka, Florida, by Mr. Rehn, I give it place only as a foot-note. Color in life deep blackish-brown offset with dull yellowish-olive, or other such tints in form of streaks on back, and blotches on flanks and legs. Snout more or less

about $2\frac{3}{5}$; greatest width of body $1\frac{2}{3}$; width of head opposite posterior margins of eyes greater than length of head by about diameter of tympanum; snout $1\frac{3}{4}$; eye $2\frac{3}{5}$; mouth $1\frac{2}{5}$; width of mouth $1\frac{1}{8}$; interorbital space, measured from eye-sockets, 3; fore limb about $2\frac{3}{5}$ in head and trunk; hind limb when outstretched greater than head and trunk by horizontal eye-diameter. Body robust, depressed, and with very evident swollen appearance, when viewed above slightly ovoid with bulge at pelvic processes and then rather well constricted back. Surface rather well-depressed both above and below, only slightly convex. Pelvic bones scarcely forming a protuberance on dorsal profile a trifle behind middle of length of head and trunk, or about $\frac{5}{9}$ in this space, and processes very obsolete. Head moderate, broad, rather depressed both above and below, though upper surface altogether more evenly convex. Snout short, broad, bluntly convex, its length a little less than half its width, when viewed above broadly and rather evenly convex, and in profile forming an obtuse angle about opposite nostril, anterior portion of which is nearly vertical. Eye very prominent, well elevated, a little

brownish marginally. Markings on flanks and upper surface of hind legs most brilliant. Feet and lower surface of all limbs more or less pale translucent brownish. Fore feet a little whitish above. Upper border of elevated eye-socket with yellowish circle and tints of same along margins of jaws. Many of little tubercles on side with yellowish, producing a somewhat spotted appearance. Femoral region of hind limbs duller and more brownish above than rest of upper surface of same. Lower surface of body dull whitish, more or less soiled or livid on lower surface of pelvic region and hind legs. Edge of lower jaw pale or whitish. Iris and eye generally black, ring encircling pupil of beautiful metallic gilt-like tint, and black of iris infringing irregularly in quarter divisions. This toad has a very peculiar habit of attempting to dig backwards by means of the black-edged spur on the hind foot, which it will rub rather fast and with good force against the palm if held in the hand. By a similar process it sinks into the ground or among grass. The eyes can be depressed considerably and give the head quite a different appearance if the animal is annoyed. It progressed usually by short hops or leaps, though sometimes crawled or walked slowly a few steps. In repose the usual position is to squat flat, and if then disturbed to inflate the flanks greatly. When held in the hand it uttered a note similar to the call of *Rana clamata*, which may be said to somewhat resemble a smothered rattle or trill of rather harsh and low tone. The throat is inflated, though not very abnormally. This note seems to be due rather to discomfort than anything else. In captivity I could not induce the specimen to eat.

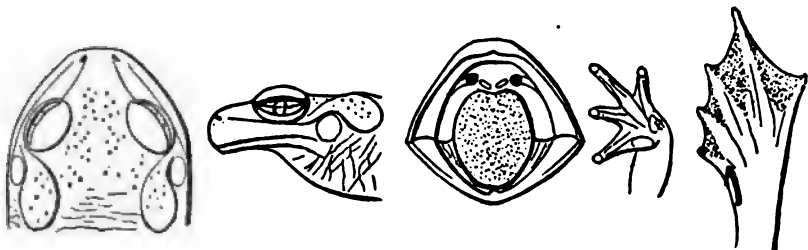
longer than deep, and its posterior margin about midway between tip of snout and axilla. Pupil vertical. Upper covering of eyeball rather tough and forming a more or less horizontal upper boundary to iris. Greatest depth of eye about $1\frac{1}{4}$ in its length. Mouth large, gape very slightly convex in profile, with convexity superior. Rictus reaches nearly opposite front margin of tympanum. Lips thin, horny or firm and with upper overlapping edge of closed mandible. Edge of upper jaw rather trenchant, that of lower a little rounded or convex and thicker. When viewed below mouth broadly and evenly convex, with more constricted convexity of upper jaw projecting in front. Front of upper jaw as viewed in front with a very slight median marginal notch. No mandibular process at symphysis. Along edge of upper jaw a cutting-edge made up of minute obsolete teeth and this concealed by upper lip. No mandibular cutting-edge. Upper buccal fold rather firm and moderately wide. Vomerine teeth minute, in 2 small patches, each about half size of internal nostril, separated for a space about equal to their own size, and placed a little posteriorly in space between internal nostrils. Tongue large, fleshy, its surface minutely papillose, only attached in front, behind and sides entirely free, rather broadly ovate and its posterior margin with a slight median notch. Internal nares large, a trifle further apart than external nostrils, and rather elongated transversely. External nostrils small, a little high on front side of snout, directed superiorly, and falling a little nearer eye than emargination in middle of front of upper jaw. Internasal space nearly level and about $1\frac{1}{4}$ in level and rather firm bony interorbital space. Posteriorly interorbital space rather convex. Loreal region deep, bevelled or slightly concave on surface. Tympanum distinct, close behind orbit, mostly below, ellipsoid, sloping forward till its lower front margin is nearly opposite posterior margin of eye, and its width about $1\frac{1}{3}$ in its own length. Skin of back minutely tuberculous, and on flanks slightly more coarsely. Upper surfaces of limbs scarcely minutely tuberculous, and nearly smooth like entire under surface of body. Parotids small, prominent, convex and rather broad. Fore limb inserted a little before first third in length of head and trunk, moderately robust, and reaches back well beyond

insertion of hind limb. Arm well developed, and hand much shorter than fore arm. Fingers 4, large, rather slender, depressed above somewhat, especially basally where broader, and surfaces all rounded convexly. A thickened web between bases of fingers very narrowly. Palmar tubercles 2, one about center of palm and other at base of first finger. Also a third obsolete palmar tubercle external and close to median one. No distinct tubercles on under surfaces of fingers though tips of each developed as one. Third finger longest, more slender than others, and about 3 in rest of arm to shoulder. First finger next in size, broader. Second finger still shorter than first or a trifle longer than fourth which is about half length of third. On inner and upper faces of 2 inner fingers a blackish and callous thickening of epidermis. Hind limb strong, heel of extended hind leg reaching to posterior edge of tympanum, femoral region about equals tibial, and space between tip of fourth toe and heel but a little greater than rest of limb measured to groin, though about of same length as space from outstretched heel to vent. Toes all depressed and covered with thick skin, which also forms thick uniting web. Fourth toe longest, and measured from base about $3\frac{1}{2}$ in space to groin. Fifth or outer toe about $2\frac{1}{2}$ in fourth, and connected by web extending from outer phalange to front margin of second or subterminal phalange of fourth toe. Other toes all graduated down from fourth toe to first, which is much shortest, and also all united by a broad terminal web, all united to last phalange except that of fourth toe, where unison is subterminal. Sole of foot perfectly smooth except an elongate horny wedge-like keel, blackish in color, with a sharp horny edge, and placed at base of inner toe. Also a trace of same is seen on inner edge of tip of inner toe. Tips of toes rounded though scarcely tuberculous. Color in alcohol dull brownish above. Head gray-brown above, as on upper surface of snout and inter-orbital space. Edge of upper jaw broadly pale brown. From behind each eye, very slightly convergent at first, a pale brownish streak runs back towards coccyx where it converges. At their convergence they form a sort of expanded pale brownish area. Sides of trunk above deep dusky-brown obscurely mottled with darker and paler. Lower surface of body pale brownish-white.

Feet all brownish, tips of toes of hind limbs a trifle darker brownish. Upper surfaces of all limbs gray-brownish, a trifle darker than lower surfaces. Upper covering of eye deep brownish above. Iris beautiful grayish, a dark grayish to dusky horizontal streak across, and pupil pale. Length from tip of snout to tip of fourth toe $5\frac{3}{8}$ inches. Cape May. June 28th, 1907. O. H. Brown.

The above described is the only New Jersey example I have examined. It was found in a big pile of soil in Cape May City by a colored laborer, about 3 feet under the earth, and changed color considerably after being in captivity a short time. I am indebted to both Mr. Brown and Mr. H. Walker Hand for this interesting specimen.

This may be distinguished chiefly by the spur on each heel. In life it is olive-brown with a yellowish band on each side.



Spade Foot Toad. *Scaphiopus holbrookii* (Harlan).

They are noted for their irregular and erratic appearance during warm weather, their burrowing in the ground tending to their escaping observation. About Trenton, according to Dr. Abbott, it may appear at any time between May and September, and erratically in abundance. They make a great noise, and as the egg-laying varies in time, their notes may also be expected to be heard at different times. During copulation, both animals roar so that they may be heard at the distance of half a mile. This roar is not like that of the common toad, *Bufo*, and their vocal apparatus is not especially different during the operation. They will also roar at other times, as when disturbed or during heavy rains. In size, the largest example equalled those of the largest of our common toad. Mr. R. C. Abbott

informs me that he heard a few during the springs of 1904 and 1906. Dr. Dahlgren tells me he secured examples near Trenton, from the same locality where Dr. Abbott made his observations.

Scaphiopus holbrooki Abbott, Am. Nat., XVIII, 1884, p. 1075.—Sherwood, Proc. Linn. Soc. N. Y., 1897-98, No. 10, p. 17.

Scaphiopus holbrookii Cope, Bull. U. S. Nat. Mus., No. 34, 1889, p. 298.

Scaphiopus solitarius Holbrook, N. Am. Herp., Ed. 2, IV, 1842, p. 109, Pl. 27.—Abbott, Geol. N. J., 1868, p. 804.—Abbott, Nat. Rambles, 1885, p. 476.

Family HYLIDÆ.

The Tree Toads.

Upper jaw toothed. Vertebrae procœlous, without ribs, sacral dilated. Fingers and toes free or webbed, their tips usually more or less with dilated disks, and bases swollen. Sternum cartilaginous. Pupil usually horizontal. Tongue usually slightly nicked, or entire.

A large family, especially characteristic of the vast forests of tropical America. They are remarkable for their varied and loud voices from early spring till frost.

Key to the genera.

- | | |
|-----------------------------------------------------------------------|------------|
| a. Toes not webbed, free or nearly so. | PSEUDACRIS |
| aa. Toes webbed. | |
| b. Finger and toe disks small; fingers not webbed. | ACRIS |
| bb. Finger and toe disks round, conspicuous; fingers somewhat webbed. | HYLA |

Genus PSEUDACRIS Fitzinger.

The Swamp Tree Toads.

Pseudacris triseriatus (Wied).

PLATE 20.

Swamp Tree Toad.

Body rather long, head $2\frac{2}{3}$ in its length measured to end of trunk, and excluding hind legs; width $3\frac{1}{2}$ to 3. Vomerine teeth

nearer each other than to nares. Tympanum rather small, 3 in eye. Upper surfaces granulated or rugose. Limbs rather stout, tibia measuring half distance from vent to middle and anterior border of orbit. Heel extends to orbit. Toes fringed or margined. A single inner tarsal tubercle. Five longitudinal bands dorsally, median broad, unites with interocular triangle, and continued part way to end of muzzle, giving a cruciform figure, and lateral bands nearly straight, commencing some distance above and within tympanum. Lateral stripe complete from end of muzzle to groin. Ground-color fawn, below pale and immaculate. Posterior limbs with half cross-bands.

Found abundant on sides of pools and ponds in the neighborhood of Gloucester, in the spring and early part of the summer. It delights in those small and often temporary pieces of water



Swamp Tree Toad. *Pseudacris triseriatus* (Wied).

which are enclosed in the densest thickets of spiny *Smilax* and *Rubus*, with scrub oaks, and surrounded by the water-loving *Cephalanthus*, where no shade interrupts the full glow of sunlight. Here they may be heard in the hottest part of the day, accompanied with a few scattering *Acris*, or rarely a *Hyla pickeringii*. Their retreats are not sought by *Ranae*. As they scarcely swim, when surprised they seek refuge in the edge of the water, with so little movement as to render their capture no easy matter. They commence their season early. They were heard in the swamps of the barrens and thickets of the southwestern part of the state as early as March 20th, when a skim of ice covered part of the water. In other level parts of the state they were heard later in the season. Their note resembles that of *Acris* in being

crepitant, and differs from the toned cry or whistle of the *Hyla*. It is not so loud as the former and is deeper pitched. It may be imitated by drawing a point strongly across a coarse comb, commencing at the bottom of a jar and bringing it rapidly to the mouth, or better, by restraining the voice to the separate vibrations of the vocal cords, and uttering a bar of a dozen or 20 vibrations, beginning with the mouth closed and ending it well opened. (Cope.)

This species I have not yet determined from within the state and know it only from the above account. It appears variable, and owing to its seclusive habits and small size may be easily overlooked. The generic name *Pseudacris* will replace *Chorophilus*, of older usage, on account of priority.

Chorophilus triseriatus Cope, Bull. U. S. Nat. Mus., No. 34, 1889, p. 342.—Stone, Am. Nat., XL, 1906, p. 162.

Genus ACRIS Duméril and Bibron.

The Cricket Toads.

Acris gryllus crepitans (Baird).

PLATE 21.

Cricket Frog. Savana Cricket. Savanna Cricket Frog. Peeper.
Rattler.

Head, measured to posterior edge of tympanum, 3 in body to end of trunk, not including hind limbs; depth about $3\frac{1}{3}$; greatest width of body $2\frac{3}{5}$; snout $2\frac{1}{2}$ in head; eye $2\frac{1}{2}$; mouth about $1\frac{1}{5}$; width of mouth equal to space between tip of snout and middle of tympanum; interorbital space measured from eye-sockets $3\frac{1}{2}$; fore limb about 2 in head and trunk; head and trunk $1\frac{2}{3}$ in hind limb. Body depressed, both above and below, and when viewed from above rather elongately ellipsoid, with bulge about midway in length of combined head and trunk, constrictions tapering rather evenly anteriorly and posteriorly. Form rather slender and graceful, and pelvic processes forming but

slight angle in last third of head and trunk, and hardly elevated. Head rather small, rather narrow and convergent anteriorly, depressed both above and below with former surface but little elevated, though a little more convex and obtuse in front profile. Snout rather broad, length about $\frac{3}{5}$ of breadth, convex over surface, and edge rather narrowly convex in front as viewed above. Eye a little elongate, a little elevated, and placed about midway between tip of snout and shoulder, or over last third of mouth. Mouth large and gape nearly horizontal. Lips thin and edge of upper more or less extending over lower all around. Lower lip firm and scarcely developed. Viewed below mouth rather broad posteriorly, rami converging rather widely in front in a rather wide convex edge so that edge of snout protrudes well in front. A series of minute teeth in upper jaw, even and more or less concealed by lips. Vomerine teeth as 2 approximated patches



Cricket Frog. *Acris gryllus crepitans* (Baird).

of small teeth convergent posteriorly between inner nares. Tongue rather large, broad and slightly emarginate behind, and convergent narrowly anteriorly where attached, sides and posterior portion entirely free. Surface minutely papillose. Internal nares far apart and rather large. External nostrils high on sides of snout in front and rather close together, space between about $\frac{2}{3}$ that of internal pair. Internasal and interorbital spaces shallowly concave. A depression at loreal region. Tympanum small, rounded, about half of orbit, and placed behind and partly below eye, but entirely after rictus. Skin above with rather scattered pustulations or warty elevations with numerous pores opening between and on them. These pustules most numerous on sides and anteriorly. Some are considerably larger and longi-

tudinal, appearing most distinct near edges of vertebral streaks. Lower parts more or less finely granular, except most of limbs and breast, which are more or less smooth. Postfemoral region granular. A cutaneous fold across breast. Fore limbs inserted about first $\frac{3}{8}$ in head and trunk, slender, and when appressed reaching back beyond groin to vent. Hands rather long and well developed, about as long as fore arm. Fingers 4, slender, rounded, not webbed, and slightly dilated at tips into very small disks, which are convex beneath and with a nail-like groove. Third finger longest, 2 in rest of arm, and others more or less subequal, with second a trifle shortest. A small tubercle at each articulation of phalanges below as 2 on first fingers (always counting disk) and 3 on each of others. Internal and external palmar tubercles well developed. Hind limb very long and slender, tibial region longer than femoral, and when combined rest of limb $1\frac{1}{4}$ in their length. Toes long, slender and with slight terminal disks, and fourth measured to carpus $\frac{2}{3}$ length of space from its tip to heel. Toes all graduated down to first, which is shortest, and third and fifth subequal, longer than second. Webs of toes extending to tips of phalanges, except external of middle. Below, each toe with a tubercle at each articulation, 2 on first and second (counting disks), 3 on third and fifth and 4 on fourth. Internal and external carpal tubercles very small. Color in alcohol brownish above, blotched with darker. A dark dusky triangle between eyes and with end pointing posteriorly. Back obscurely blotched with blackish. A large broad blackish blotch back from eye towards groin passing just over shoulder. Just above groin an oblique blackish blotch. Groin and femoral region more or less tinged with yellowish. Belly whitish. Throat yellowish-white soiled with dusky. Upper lip with some whitish specks. Lower lip whitish with some dusky specks. Limbs brownish like back above, and pale like belly below. Postfemoral region yellowish with longitudinal blackish streaks above. Upper femoral region like back, with 2 blackish blotches. Tibial region like back, with about 3 obsolete blackish blotches. Tarsus with several blackish blotches on its dark surface. Feet and hands largely brownish. Length $2\frac{1}{4}$ inches. Rancocas

Creek, at Centerton, in Burlington County. October 14th, 1906. T. D. Keim and H. W. Fowler.

Color in life olive-brown above, tubercles of back with more plain brownish tints, upper surface of limbs olive-brownish, marbled with darker. A larger blackish blotch from behind eye to groin, bounded below by pale line of whitish. Upper lip and side of lower, blackish, which color extends back to shoulder. Upper lip with a few whitish specks. Lower lip, otherwise than stated, whitish. A triangular dusky-black blotch between eyes, with angle directed back, and its edge a trifle pale olive all around. Black shade from eye continued above each side of back to groin, then towards vent, where it joins its fellow. Groin olive-green tinted, this shade extending half way to costal region. Each side of femur gamboge tinted, posteriorly bounded with dusky extending from vent. Knee dusky, with 3 blackish blotches on dark color of femur above. Dusky blotches on tibia above. Ventral or anal region blackish, spotted with white. Tarsus and feet brownish, tubercles and toes dark red. Lower surface of hind legs translucent brownish-white, with dull olivaceous tints about femur. Lower surface of fore legs whitish, becoming translucent brownish on ulna, fingers yellowish-brown, and their tips orange tinted. Tips of toes of hind legs also orange tinted. Lower surface of body creamy-white. Throat whitish, marked with dirty yellowish. Iris brown. Length of body from tip of snout to end of pelvis $\frac{3}{4}$ of an inch. Fresh-water pond at edge of the salt-marsh, in Cape May County, at Palermo. April 15th, 1906. George Z. Hartman, T. D. Keim and H. W. Fowler.

These little toads were found to be very abundant, though exceedingly difficult to see, on account of their small size and close resemblance to the aquatic vegetation in which they live. Their notes were a characteristic feature of these ponds all along the marshes most of the time, and also in the cedar-swamps. They appear to be somewhat shy, and sink or disappear without leaving any trace of their whereabouts. They also become silent if peeping when one approaches the pond. Dr. Abbott finds this little toad the earliest to speak in the spring about Trenton, though he tells me he has not yet heard them in the fall. Besides their rattling call a

squeaky sound was heard occasionally, though only during the breeding-season. They were much more abundant than *Hyla pickeringii*. After the eggs were laid Dr. Abbott found them to be quiet, not making any noise till spring, when they would seem to disappear till about the middle of July or the first of August. However they would not then resume their noise. I have heard them in various places, more or less regularly, from spring all through the summer, and on several occasions in Dr. Abbott's own meadows. It may be stated that in my experience their call appears to be variable. The usual note is not heard at a great distance, and is described by one writer as exactly imitated by striking two marbles together, first slowly, then faster and faster, for a succession of about 20 to 30 beats. Perhaps the rattling of castanets would be a better suggestion. The animals live in the grass and take enormous leaps, seldom if ever frequenting trees or bushes. When disturbed they usually swim or leap, but rarely sink below the surface of the water, and *if seen* are easily secured. The species varies much in color without regard to locality. Some are very bright and others pale. Mr. H. Walker Hand and myself found them abundant in the fresh waters, adjacent to the salt-marshes at Cape May, in April of 1903. I have examined many examples from the various localities already mentioned, besides others procured by Mr. Samuel N. Rhoads from White Pond, Swartzwood Lake, and Cedar Lake in Warren county taken in October, 1895, Culver's Pond in Somerset County taken in October 1894, and Sussex County. Examples from New Jersey procured by Dr. Pickering have also been examined. October 10th, 1906, I found a number of examples near Trenton Junction.

Acris crepitans Baird, Proc. Acad. Nat. Sci. Phila., VII, 1854-55 (1856), p. 59.—Abbott, Am. Nat., XVI, 1882, p. 707.—Abbott, Nat. Rambles, 1885, p. 476.

Acris gryllus crepitans Cope, Bull. U. S. Nat. Mus., No. 34, 1889, p. 326.—Sherwood, Proc. Linn. Soc. N. Y., 1897-98, No. 10, p. 18.—Stone, Am. Nat., XL, 1906, p. 162.

Rana gryllus Harlan, Journ. Acad. Nat. Sci. Phila., V, pt. 2, 1827, p. 340.—Harlan, Med. Phys. Res., 1835, p. 104.

Hylodes gryllus Holbrook, N. Am. Herp., III, 1838, p. 75, Pl. 13 (ref. in fers).—Holbrook, l. c., Ed. 2, IV, 1842, p. 131, Pl. 33.—Abbott, Geol. N. J., 1868, p. 805.

Rana dorsalis Harlan, Med. Phys. Res., 1835, p. 105, fig. 1 [on plate opposite p. 72].

Genus *HYLA* Laurenti.

The True Tree Toads.

Key to the species.

- | | |
|------------------------------------------------------------------------|-------------|
| a. Patches of vomerine teeth posterior to line between interior nares. | PICKERINGII |
| aa. Patches of vomerine teeth on a line with interior nares. | |
| b. Phalanges of fourth toe with 3 free from web. | ANDERSONII |
| bb. Phalanges of fourth toe with 2 free from web. | VERSICOLOR |

Hyla pickeringii (Holbrook).

PLATE 22.

Pickering's Tree Toad. Peep. Peeper.

Head measured to posterior edge of tympanum, 3 in body to end of trunk, not including hind limbs; depth about 3 normally; greatest width of body $2\frac{1}{2}$; snout a trifle over 2 in head; eye $2\frac{3}{4}$; mouth about $1\frac{1}{10}$; width of mouth about equal to length of head; interorbital space measured from eye-sockets $2\frac{1}{6}$; fore limb about 2 in head and trunk; head and trunk about $1\frac{3}{5}$ in hind limb. Body broad, depressed both above and below, and when viewed from above of somewhat ovoid pattern, with greatest bulge a trifle posterior to middle of length of head and trunk. Constriction posteriorly greater than that anteriorly, which is obtuse. Form broad above, especially anteriorly, otherwise slender, and pelvic bones barely forming an angle at last $\frac{3}{8}$ of head and trunk. Head broad, rather large, well depressed both above and below, and obtuse in front. Snout short, broad, convex both over surface and in profile as viewed

above, and its length about $\frac{2}{3}$ its width. Eye a little elongate, scarcely elevated in profile, and about midway between tip of snout and shoulder, or about over last fourth of mouth. Mouth large and gape horizontal. Lips thin, firm, upper slightly overlapping lower all around when mouth closes. Lower lip firm, scarcely developed. Viewed below mouth appears broadly convex with upper edge of snout well produced in front. Teeth along edge of upper jaw uniserial, even, obsolete, minute, more or less concealed by upper lip and absent from mandible. Vomerine teeth small, in 2 posteriorly approximated patches a little behind median line between internal nares, and but slightly separated. Tongue large, ovoid, broad, posterior edge barely notched, surface minutely papillose and largely free except anterior attachment at symphysis. Internal nares rather large and placed equidistant to edges of bony interorbital width. External nostrils near upper front lateral edge of snout and space between



Pickering's Tree Toad. *Hyla pickeringii* (Holbrook).

barely more than half of interorbital space. Internasal space shallowly concave. Interorbital space with shallow concave median depression, and over each eye a slight convexity. Loreal space with an oblique depression from external nostril to eye. Tympanum deeper than wide, vertical diameter about $\frac{2}{3}$ of horizontal orbital diameter, rounded, short space behind eye, half below, and middle about over rictus. Skin smooth, sparsely pustular above, and under surface closely granulated over most all portions. Pectoral region and chin sparsely granulated. Granules on belly largest and best defined. A cutaneous fold across breast not especially pronounced. Fore limbs inserted about first $\frac{2}{3}$ in head and trunk, rather slender, and reaching a trifle beyond insertion of hind limbs, though not to vent. Fingers rather long, 4, rather broadly depressed, dilated at tips into broad disks, and that on third finger about half size of

tympanum. No web at bases of fingers. Third finger longest, about half rest of arm, and others all more or less subequal. Disk on inner finger smallest. Counting disks on each lower surface of fingers at articulations of phalanges 2 on first and second, and 2 on each of others. A couple of small palmar tubercles. Hind limb long, slender, femoral region a little less than tibial, and rest of limb $1\frac{1}{4}$ in their combined length. Fourth toe to tarsus $\frac{4}{7}$ space of heel, longest, and others all graduated down to first which is shortest, third and fifth subequal and next in size to fourth. A slight basal web. Disks well developed on toes, according to size of latter. At articulations of phalanges tubercles on lower surfaces. Counting disks 2 on first, 3 on third and fifth, and 4 on fourth. Sole with 2 rather small tubercles, one at base of each outer digit. Vent superior. Color in alcohol pale brownish with a well-defined narrow lined or Saint Andrew's cross of dusky on back. A \vee -shaped mark a short distance behind cross on each side, with direction parallel to posterior of cross angle. Another broad \vee -shaped mark between eyes with angle directed back. A deep brown streak from front side of snout through eye and fading out at groin. Legs barred above with transverse brownish streaks, and whole upper parts sprinkled with dark dots. Posterior femoral region variegated brownish, and anteriorly plain. Feet pale brownish. Iris slaty. Length $2\frac{5}{16}$ inches. Found about sticks on side of hill above Kinkora, on Kinkora Creek, in Burlington County. October 16th, 1906. Dr. C. C. Abbott, T. D. Keim and H. W. Fowler.

Color of the above in life, above nearly flesh-color with a slight tinge of coppery reflected in some lights. Cross on back of faint gray, bifurcate behind on each side backwards. Interocular bar gray. Bar across each femur and tibia gray. Lower surface of body translucent brownish. Throat and femoral region dull brownish-yellow. Granulations on belly whitish. Feet translucent brownish. A brownish streak from tip of snout to eye, then back over tympanum, and afterwards continued to groin as a grayish blotch.

Dr. Abbott says it is similar in habits to *Acris* in spring, but becomes arboreal about Trenton in the fall and winter. Its note

is shrill, though not continuous. The vocal sac collapses suddenly or very quickly, suddenly distends, and then collapses again as the peep is heard. They do not appear to him to vary much in color. The throat or vocal sac is dusky-purple in the breeding season. During the very mild January of 1906, Dr. J. Percy Moore reports them as having been heard near Woodbury, and Mr. J. A. G. Rehn also reports that several weak notes were heard near Staffords Forge or West Creek, Ocean County. At the same time Dr. Abbott also noted it at Trenton. Near Sewell on April 1st, 1906, I heard a number of these toads by midday. The morning was cold at first with thin ice all about, which in a short time had thawed in most places, so that in the hollows, which were apparently not at all frozen during the night, some of these toads peeped occasionally. Perhaps only several calls would be heard at rather rare intervals, and then in a short time others growing more numerous. The animals were in all probability only aroused from their benumbed state by the warm action of the sun. On the upland the action of the wind, which was blowing, made it difficult at times to make out their cries. Though said to be our most abundant eastern species, it is seldom found, and is in evidence usually through its voice. Cope states, as I have observed, that "after the rattling of the *Acris gryllus* in the marshes and river banks in the lowlands is fairly under way, during the first bright days of spring, the shrill cry or whistle of this little creature begins to enliven the colder swamps and meadows of the hill country. Different individuals answer each other with differently toned voices of a single note. This is exceedingly shrill and loud; the muscular force employed in expelling the air from the lungs seems to collapse the animal's sides till they nearly meet, while the gular sac is distended with each expulsion to half the size of the head and body together. They are chiefly noisy in the end of the afternoon, but in shady situations or on dark days may be heard through the morning and noon. When the breeding season is over they may be still found, but with difficulty, among fallen leaves in low places, where their color admirably adapts them for concealment, or in cellars, or on the ground in the woods. Not till the approach of autumn do we have evidence of their ascent into the trees. Then when the wind is

casting the first frosted leaves to the ground, a whistle, weaker than the spring cry, is heard, repeated at intervals during the day, from one part of the forest to another, bearing considerable resemblance to the note of the purple finch, *Carpodacus purpureus*, uttered as it is flying. These voices are heard during the same season, that of the *Hyla* being distinguishable as slightly coarser, or more like a squeak. Both are associated with the weak chirp of the *Dendroica coronata* as it gleams its insect food on its southern flight. These are the latest sounds of autumn, and soon disappear before the steady advance of the ice king."

Hylodes pickeringii Abbott, Geol. N. J., 1868, p. 805.

Hyla pickeringii Abbott, Nat. Rambles, 1885, p. 476.

Hyla pickeringi Sherwood, Proc. Linn. Soc. N. Y., 1897-98, No. 10, p. 19.

Rana ocellata Forster, Transl. Kalm's Trav. N. Am., I, 1770, p. 379.

Hyla andersonii* Baird.

PLATE 23.

Anderson Tree Toad.



Anderson Tree Toad. *Hyla andersonii* Baird.

Head, measured to posterior edge of tympanum, 3 in body to end of trunk, not including hind limbs; depth 4, most likely much less in life; greatest width of body $2\frac{3}{5}$, and this also greatest width of head; snout $2\frac{1}{10}$; eye 3; mouth about $1\frac{1}{20}$; width of mouth greater than head; interorbital space, measured from eye-sockets, $2\frac{3}{5}$; fore limb a little over half length of head and trunk; head and trunk about $1\frac{2}{5}$ in hind limb. Body broad,

* The *Proc. Nat. Sci. Assoc. Staten Is.*, III, 1893, p. 2, contains an erroneous record for Clifton on Staten Island, N. Y., afterwards corrected in the same journal by J. C. Thompson, 1893-95 (1896), p. 13.

depressed both above and below, and when viewed above elongately ovoid, bulge anterior, or at shoulders, and profiles gradually convergent posteriorly. Form slender, and pelvic bones forming but slight angle near last $\frac{3}{7}$ in length of head and trunk, though processes not especially elevated. Head rather large, broad and obtuse, depressed both above and below, with former surface more convex and latter more or less flattened. Snout short, broad, convex both over surface and in profile as viewed above, its length about half its width. Eye a little elongate, a little high, placed nearly midway between tip of snout and shoulder, or about over first $\frac{3}{5}$ in gape of mouth. Mouth large, gape nearly horizontal, or but slightly undulate in profile. Lips thin, and upper overlapping edge of mandible when mouth closes. Lower lip very firm, or hardly developed. When viewed below mouth appears slightly more broadly convex than profile of upper jaw, which protrudes a little in front. Teeth absolutely minute and apparently uniserial above, perhaps none in mandible. Vomerine teeth minute, about $\frac{1}{4}$ of eye horizontally, in 2 oblique series convergent towards parasphenoid between internal nares. Tongue large, broad, rounded, slightly indented posteriorly, and surface finely papillose. Tongue broadly adnate in front though sides posteriorly, and all of posterior edge, free. Internal nares placed equidistant to edges of bony interorbital width. External nostrils well within limits of bony interorbital space, a little superior on front side of snout. Internasal and interorbital spaces more or less levelled, median depression slight. Loreal region slightly concave. Tympanum rounded, a little deeper than wide, and close behind eye above rictus, its vertical diameter about $\frac{2}{3}$ of orbit horizontally. Skin above smooth, minutely corrugated. That on limbs similar. Throat, belly and lower femoral region areolated, or presenting a papillose appearance. Apparently no keels or glandular folds. A cutaneous fold across throat, and another across breast. Fore limbs inserted about first third of head and trunk, slender, and when appressed reaching a trifle beyond groin. Fingers 4, slender, disks small, or less than half diameter of tympanum, barely depressed towards their bases, and not webbed. Third finger

longest, a trifle over 2 in rest of arm, and other fingers all more or less subequal. At each articulation of phalanges a small tubercle. Palm with 2 rather large tubercles, outer a little larger. Hind limb very long and slender, femoral and tibial parts equal, though remaining portion of limb a little longer. Toes long, slender, webbed a little basally, fourth longest, $3\frac{3}{5}$ in space to heel, first shortest, second a little longer, and third and fifth subequal, though still a little longer. Disks small. Internal metatarsal tubercle ovoid and distinct, though none external. Vent superior. Color in alcohol faded dull brownish above, and whitish below. Eyes slaty. Length nearly 4 inches. In a swamp near Jackson. Dr. Joseph Leidy.

Color of the above in life. Whole upper surface a rather deep pea-green, paler upon sides and margin of upper lip. A narrow band of purplish-brown commences at the external nares, passes through eye and including tympanum, loses its lower border a little beyond insertion of humerus. Color becomes paler upon sides, where it is of an ashy-mulberry tint, and extends as far as origin of femur. Anterior to this point margined below by large irregular spots of beautiful saffron, which are continued upon anterior and posterior faces of femur and whole under surface of tibia, upon a ground of a paler shade of same color. Upper front surface of tarsus, 3 inner toes and webs of external, small area behind humerus and posterior surface of latter, and lower front face of fore arm and inner finger, tinted and spotted in same manner. Upper surfaces of femur, tibia, humerus and fore arm same color as back, that of humerus separated from green of jaws by an isthmus of purplish shade, and that of tibia separated anteriorly from saffron of its lower surface by a band of mulberry. Green of back and extremities everywhere margined with pure white, except posteriorly on femur and tibia and anteriorly on former, where saffron takes its place. Green crosses rictus and forms an oval spot on each side of throat. Borders of latter and chin tinged with mulberry. Beneath whitish flesh-color. Exposed surfaces of anterior and posterior extremities where not green of a shade intermediate between mulberry and chocolate. (Cope.)

Besides the above described example I have examined the one collected at Clementon in Camden County, May 14th, 1901, by Mr. H. L. Viereck. I remember having seen this in life. It was then bright pea-green above. After having been in alcohol several years it has changed to a plumbeous or slaty-gray color above with paler or whitish borders to brownish of sides and dark lateral stripes. The limbs though plumbeous above are only so to carpus and tarsus, which are a pale brownish like entire under surfaces of limbs. Throat, breast and belly pale or whitish. This example is about $1\frac{7}{8}$ inches long. Dr. Abbott tells me that the example Peters sent to him from May's Landing alive uttered a sound more like a clatter, or sharp click, something like that made by the virginia rail. The vocal vesicle resembled that of *Hyla versicolor*. It appeared to take in a big breath and produced about 6 clicks as the air escaped. Mr. Peters reported that he heard a sound which was more shrill than the one described above, and then captured the specimen. Mr. Witmer Stone mentions that he heard some tree toads in a swamp near Medford whose call was different from that of any other species with which he was acquainted, so that he was inclined to think it was possibly that of the present form. No examples were obtained. However in view of this it may be questioned if the animals were not *Pseudacris* or some other *Hyla*?

Besides the above examples this species is now known from only 4 other recorded examples, and the type taken at Anderson, South Carolina. These are, 1 from May's Landing taken June 1st 1888 (Rev. J. E. Peters), 2 from Pleasant Mills June 17th 1889 (Dr. J. Percy Moore), and 1 from Lakehurst September 5th 1905 (Mr. Wm. T. Davis). Mr. Davis recently reports it abundant at the latter locality.

Hyla andersonii Cope, Proc. Acad. Nat. Sci. Phila., 1862, p. 154.—Abbott, Geol. N. J., 1868, p. 805.—Cope, Bull. U. S. Nat. Mus., No. 34, 1889, pp. 365, 459, Pl. 83, fig. 1 (type figured).—Peters, Am. Nat., XXIII, 1889, p. 58.—Abbott, Am. Nat., XXIV, 1890, p. 189.—J. P. Moore, Am. Nat., XXVIII, 1894, p. 1045.—Stone, Proc. Acad. Nat. Sci. Phila., 1901, p. 342.—Davis, Am. Nat., XXXVIII, 1904, p. 893.—Davis, l. c., 1905.

p. 795.—Stone, Am. Nat., XL, 1906, p. 163.—Dickerson, Frog Book, 1906, p. 131, Pl. 7, figs. 1-4.—Davis, l. c., XLI, 1906, p. 49.

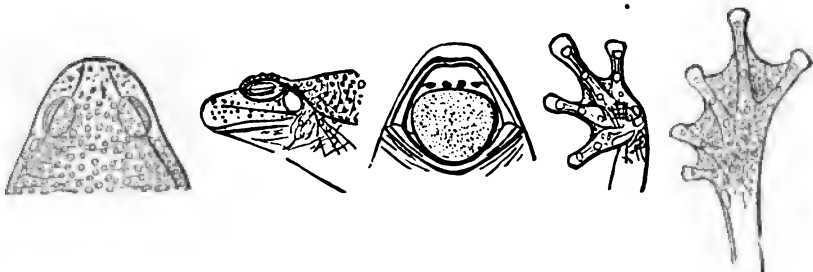
Hyla andersoni Sherwood, Proc. Linn. Soc. N. Y., 1897-98, No. 10, p. 19 (comp. evid.).

***Hyla versicolor* Le Conte.**

PLATE 24.

Common Tree Toad. Tree Toad. Tree Frog.

Head, measured to posterior edge of tympanum, 3 in body to end of trunk, not including hind limbs; depth $2\frac{2}{3}$; greatest



Common Tree Toad. *Hyla versicolor* Le Conte.

width of body 2; snout $2\frac{1}{3}$ in head; eye $2\frac{2}{5}$; mouth about $1\frac{1}{10}$; width of mouth much greater than head; interorbital space, measured from eye-sockets, $2\frac{1}{4}$; fore limb about $\frac{1}{2}$ in head and trunk; head and trunk about $1\frac{1}{2}$ in hind limb. Body broad, depressed both above and below, and when viewed from above slightly ovoid with bulge a trifle posterior to middle of length of head and trunk, then constricted rather gradually posteriorly. Form rather robust, and pelvic bones forming but slight angle about first $\frac{3}{5}$ in head and trunk, though processes not especially elevated. Head large, broad, depressed both above and below with former surface perhaps a little more convex and obtuse in front. Snout short, very broad, convex both over surface and in profile as viewed above, and its length about $2\frac{1}{3}$ in its width. Eye a little elongate, high, and about midway

between tip of snout and shoulder, or about over first $\frac{3}{5}$ of gape of mouth. Mouth large, and gape nearly horizontal. Lips thin, firm, and upper overlapping edge of mandible when mouth closes. Lower lip very firm, scarcely developed. Viewed below mouth broadly convex, slightly more so than upper profile of head, as snout and upper lip protrude a little. Teeth obsoletely uniserial in upper jaw, and apparently absent from mandible. Vomerine teeth small, in 2 small patches a little convergent posteriorly between internal nares, and patches but slightly separated. Tongue thick, large, fleshy, surface finely papillose, and slightly notched along its posterior edge, at which region it is also free for about half its length. Internal nares placed equidistant to edge of bony interorbital width. External nostrils well within limits of bony interorbital space, and a little superior on front side of snout. Internasal and interorbital spaces more or less levelled, and median depression very shallow. Loreal region slightly concave. Tympanum rounded, nearly circular, close behind eye above ric-tus. Skin warty, rather coarsely tubercular with finer granulations intermixed, except on loins, and anterior and posterior faces of thighs. Lower surface with granules distinct, and well-defined, though less conspicuous on throat, palms and neck. A prominent and distinct fold of skin across throat, and another across breast better developed. Fore limbs inserted about first third in head and trunk, rather short and stout, and reaching a little beyond groin, though not to end of trunk. Fingers 4, broad, depressed, dilated at tips into broad disks, and that on third finger nearly equal to tympanum in diameter. A slight web connects fingers at base. Third finger longest, about $2\frac{2}{3}$ in rest of arm, and others more or less subequal, with fourth a little shortest. Disk on inner finger smaller than others. Hind limb rather long and slender, femoral and tibial regions of about equal length, and rest of limb about a third again as long. Toes well webbed, and with well-developed disks, those of first and second least developed. Fourth toe longest, first shortest, second next in size and third and fourth about subequal. Vent superior. Color in alcohol pale brownish, with slightly deeper gray-brown blotches on back indistinctly. Across element of each limb a pair of deeper

brownish broad bars well defined. Upper femoral region mottled and vermiculated whitish and deep brownish. Lower surface of body pale brownish or creamy-brown. Limbs below, and lower surface of feet pale. Eyes gray-brown. Length $4\frac{1}{2}$ inches. Morristown. Dr. Fisher.

Dr. Abbott says it is abundant near Trenton in warm weather. They were found to have power to change color to some extent, as an example found on a beech would turn from gray to dark brown when placed on an oak. The vocal sac when inflated is very marked, though apparently it does not distend to the extent of that of *H. pickeringii*. It collapses by a series of jerks as the cry is gradually emitted. They usually do not begin to call much before late April.

Hyla versicolor Le Conte, Ann. N. Y. Lyc. Nat. Hist., I, pt. 2, 1825, p. 281.—Harlan, Journ. Acad. Nat. Sci. Phila., V, pt. 2, 1827, p. 343.—Harlan, Med. Phys. Res., 1835, p. 108.—Holbrook, N. Am. Herp., I, 1836, p. 101, Pl. 17 (ref. iners).—Holbrook, l. c., Ed. 2, IV, 1842, p. 115, Pl. 28.—Abbott, Geol. N. J., 1868, p. 804.—Abbott, Am. Nat., XVI, 1882, p. 707.—Abbott, Nat. Rambles, 1885, p. 476.—Abbott, Pop. Sci. Month., XXXIV, 1889, p. 165.—Cope, Bull. U. S. Nat. Mus., No. 34, 1889, p. 373, Pl. 64 (skeleton).—Sherwood, Proc. Linn. Soc. N. Y., 1897-98, No. 10, p. 20.

Family RANIDÆ.

The Frogs.

Upper jaw toothed. Usually vomerine teeth. Vertebrae proœlous, without ribs, processes of sacral cylindrical or very slightly dilated. Fingers 4, and toes 5, free or webbed, and with their tips sometimes dilated. Sternum usually well developed and furnished with a bony style. Pupil mostly horizontal, sometimes vertical. Tongue usually emarginate. Ear well developed, with tympanum. Liver with 3 lobes.

A large family chiefly in the Northern Hemisphere and East Indies. Most are aquatic and similar to our common frogs. A single genus within our limits.

Genus RANA Linnæus.

The True Frogs.

Key to the species.

- a. No black ear-patch conspicuous.
 - b. Males with external vocal sacs.
 - c. A glandular fold on each side of back; legs very long, heel reaching to or beyond tip of muzzle; back with 2 series of longitudinal ellipsoid blackish blotches. PIPIENS
 - cc. No glandular fold on each side of back; legs short; back with irregular obsolete blotches. VIRGATIPES
 - bb. Males without external vocal sacs.
 - d. No glandular fold on each side of back; size very large. CATESBEIANA
 - dd. Glandular folds 2 or more on back; size moderate.
 - e. A glandular fold on each side of back; back spotted irregularly or plain; tympanum of male larger than eye. CLAMATA
 - ee. Glandular dorsal folds 4; back with large quadrate brown blotches; tympanum not as large as eye. PALUSTRIS
- aa. A black ear-patch conspicuous. SYLVATICA

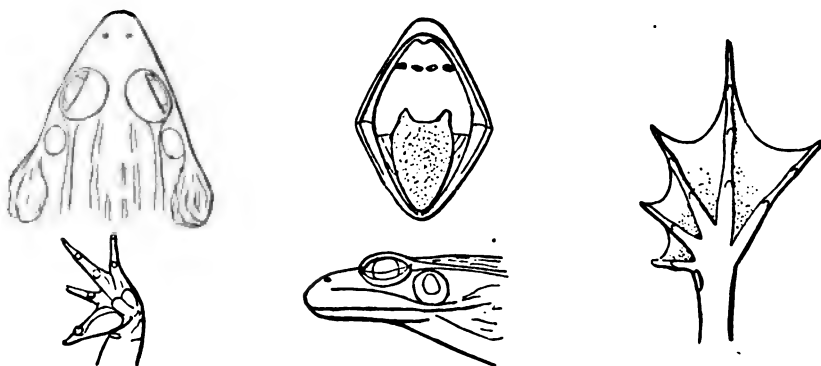
Rana pipiens Schreber.

PLATE 25.

Leopard Frog. Shad Frog. Spring Frog.

Head, measured to posterior edge of tympanum, 3 in body to end of trunk, not including hind limbs; depth $2\frac{2}{3}$ normal; greatest width of body $2\frac{3}{5}$; width of head, at posterior margins of tympani equal to its length; snout $2\frac{1}{3}$; eye $3\frac{2}{7}$; mouth $1\frac{1}{10}$; width of mouth $1\frac{1}{7}$; interorbital space, measured from eye-sockets, 5; fore limb $1\frac{4}{5}$ in head and trunk; head and trunk $1\frac{4}{5}$ in outstretched hind leg. Body rather elongately ovoid in profile as viewed above, and after bulge constriction forming evenly back. In form rather slender, or with more or less entirely ovoid trunk, depression both above and below slight, so that surface is well convex. Pelvic bones forming obtuse angle in profile along back about $\frac{3}{5}$ length of trunk, though processes not especially

elevated. Head moderately small, conic, depressed below, and less so above where slightly convex. Snout rather long, largely convex above, its length about $\frac{2}{3}$ its width, and when viewed above with rounded truncate tip to constrictions of sides. Eye elongate, not much elevated over upper profile, placed a little nearer tip of snout than shoulder, or about over first $\frac{3}{5}$ in gape of mouth. Mouth large, gape a little convex in profile with convexity superior. Lips thin, and most all of upper overlapping edge of mandible when mouth closes. Lower lip very firm, or hardly developed. When viewed below mouth rather triangular, so that it would be isocèles, though tip broadly and convexly rounded, with more truncated profile of snout protruding well



Leopard Frog. *Rana pipiens* Schreber.

beyond. Teeth fine, short, firm, more or less even, and in narrow or single series in upper jaw. Apparently no mandibular teeth. Vomerine teeth minute, in form of 2 small separate patches on each side of median line, though close to one another and between internal nares. Tongue large, ovoid, with bulge posterior, and posterior margin with a rather deep median incision. Sides and posterior part of tongue all free, and its surface minutely and densely papillose. Internal nares placed equidistant to edges of bony interorbital width. External nostrils rather conspicuous above on sides of snout, a trifle nearer its tip than eye, and internasal space about equal to that of bony interorbital. Internasal and interorbital spaces nearly evenly level or with but slight median depression. Loreal region slightly con-

cave. Tympanum rounded, close behind and partly below eye, and a trifle shorter than horizontal diameter of same. Skin perfectly smooth over entire body. A number of rather large papillæ around vent, most numerous and large just below. From tip of snout on each side a glandular fleshy keel to eye, and embracing nostril in its course. From behind eye this keel larger and pale in color, and extends back to postinguinal region. In their courses these keels will be seen slightly concurrent with outer profile, as viewed above, and with their greatest divergence at ovoid bulge of same. Just along edge of upper lip a pale elevated glandular keel extends back till above axilla, and it begins on side of tip of snout. Vocal vesicles developed. Fore limb inserted about $\frac{4}{7}$ in length of head and trunk, comparatively large and robust, and when appressed reaches beyond insertion of hind limb a trifle. Fingers 4, large, attenuate, not webbed, swollen towards bases and upper surfaces only towards latter convexly depressed a little. Third finger longest, $2\frac{1}{2}$ in rest of arm, and first finger subequal. Second finger shortest, and fourth but little longer. Large tubercle on base of hand distinct, and tubercles distinct at articulations of outer 3 phalanges of second and fourth fingers, present only at articulation of second phalange of first finger, and second and third articulations of third finger. Hind limb very long, femoral region robust, and equals tibial. Space between tip of fourth toe and heel $1\frac{1}{4}$ in rest of hind limb measured to vent. Fourth toe longest, very slender, and measured to incision of longest web, $5\frac{1}{2}$ in rest of limb to vent. Web of hind limb extending on fourth toe all space except 2 terminal phalanges. Tubercles at articulations of phalanges of fourth toe 4, 2 on fifth, 3 on third, 2 on second and 1 on first. Fifth toe perhaps a trifle longer than third, and others graduated down to first. Cuneate tubercle well developed at base of first toe. Vent superior. Color in alcohol dull drab-brown above, creamy-white below, hind limbs more deeply colored, and throat and belly whiter. Back with rather elongated black blotches, a little irregular, and also extending on sides. Upper surface of hind limbs marked with similar colored bars and spots, most numerous on upper femoral region. Fore limbs

blotched somewhat similarly above, though markings larger and fewer. Feet all with some pale brownish. Glandular keels on back whitish. Iris slaty. Length 7 inches. Near Cold Spring in Cape May County October 7th, 1906. T. D. Keim and H. W. Fowler.

About Dennisville, in Cape May County, Messrs. T. D. Keim and H. Walker Hand, and myself, observed this frog in September of 1906. An adult example was brown above generally, in life, with here and there a greenish shade, especially on middle of back, and becoming greenish-yellow on groin and upper surface of legs posteriorly. Blotches on upper surface of body blackish-brown, with pale edges, and producing a somewhat ocellated appearance. Ridges down back coppery-cream, also from side of snout below eye to shoulder, only paler. Lower surface of body livid whitish, legs and feet more or less translucent. Iris coppery-brown, especially narrow ring around pupil, upper margin light, and blackish streak from pupil below to lower edge. Coloration otherwise as usual. These animals were used as pike-bait, when trolling.

Color of adult in life drab-olive above, with rather obscure ellipsoid black blotches in several somewhat irregular series. From behind each eye a pale yellowish-white streak to groin. Also 1 on each side of head from tip of snout to axilla, and a similar tint on tarsus. Lower surface of body white, sprinkled more or less with dusky around edges. Throat soiled whitish. Feet and claws brownish, and webs same tint. Tympanum brown. Iris coppery. Fresh-water pools at edge of salt-marsh, Palermo, Cape May County, April 15th, 1906. G. Z. Hartman, T. D. Keim, and H. W. Fowler. Tadpoles of several inches were olive above with obscure dusky spots. Caudal peduncle olive, fin transparent diluted warm brown specked with dusky-brown. Iris brown. Belly pale with dusky tints of pale buff and coppery on costal and green region. Throat dusky with dull gilded and coppery tints. Sides of body coppery, clouded with dusky or blackish. Found also abundantly in the fresh-marsh pools at the edge of the salt-marsh. The frogs were all in the water, and were difficult to capture, as they appeared to

be shy, quickly sinking out of sight among the aquatic vegetation, after the manner of the sphagnum frog. They would usually sit more or less submerged near shore. They uttered their cries at this season, according to reports, though we did not hear them. A large cluster of eggs was found submerged among the vegetation. Each capsule was rather elongated or lozenge-shaped. During April of 1906 many frogs were croaking in the marshes of Mantua Creek tide-water. Masses of eggs were found on the 8th. They were probably this species, and were laid only submerged in large clusters over and attached to a few dead grasses. The frogs were shy and only approached with difficulty. They immediately stopped their noise if a bird flew over, or one approached, to sink quickly out of sight. Mr. David McCadden found this species on the point at Ocean City, August 19th, 1906. His was a bright green example. Mr. Wm. J. Fox has observed them in warm weather at Sea Isle City. About Cape May they are the most abundant species on the edge of the salt-marsh in rain-soaked places, or fresh swamps. Mr. H. Walker Hand and myself first observed them in April of 1904, in company with *Acris gryllus crepitans*, *Natrix sipedon*, and *Chelopus guttatus*. Most of those we saw then were dark like the Palermo examples. During October of 1906, about the same localities, Mr. T. D. Keim and myself saw a number of interesting variations. I have examined a number of examples from White Pond in Warren County taken in October of 1895 (S. N. Rhoads), Cedar Swamp Creek (E. D. Cope), Staffords Forge on June 2nd 1905 (P. Lorrilliere), May's Landing in the fall of 1892 (S. N. Rhoads), Medford to the plains in Burlington County in June of 1901 (Witmer Stone, H. L. Coggins and J. A. G. Rehn), and Bear Swamp in Burlington County on June 17th 1901 (W. Stone and J. A. G. Rehn). Dr. Abbott says its notes are metallic and that he has found it and *R. catesbeiana* in springs, near Trenton, in winter, where they were semi-torpid. They can leap further than any of our other species. Color from the dark olive or dusky examples already noted to brilliant grass-green. Many of those observed about Millville and Manumuskine, and other places in the southern part of the state, are

usually more or less bright green, according to Mr. Witmer Stone.

An example procured along Kinkora Creek, Burlington County, was muddy-brown in life. Oval blotches on back deeper brown. Groin bright bottle-greenish marked with dusky. Spots on femoral region pale greenish. Under surface whitish, soiled pale dusky on sides. Lips pale dusky, spotted with white. Below, limbs whitish, soiled brownish. Feet pale brownish. Tubercles whitish. This is of the usual adult size. Dr. C. C. Abbott, T. D. Keim and H. W. Fowler.

Rana pipiens Stone, Am. Nat., XL, 1906, p. 163.

Rana utricularius Harlan, Journ. Acad. Nat. Sci. Phila., V, pt. 2, 1827, p. 337.—Harlan, Med. Phys. Res., 1835, p. 102.

Rana halecina Holbrook, N. Am. Herp., I, 1836, p. 89, Pl. 13 (ref. infers).—Holbrook, l. c., Ed. 2, IV, 1842, p. 91, Pl. 22.—Abbott, Geol. N. J., 1868, p. 804.—Abbott, Nat. Rambles, 1885, p. 476.

Rana virescens Cope, Am. Nat., XXV, 1891, p. 1019.

Rana virescens virescens Sherwood, Proc. Linn. Soc. N. Y., 1897-98, No. 10, p. 21.

***Rana virgatipes* Cope.**

PLATE 26.

Sphagnum Frog. Carpenter Frog.

Head, measured to posterior edge of tympanum, nearly 3 in body to end of trunk, not including hind limbs; depth about $3\frac{1}{3}$; greatest width of body $2\frac{2}{3}$; width of head at posterior margins of tympani equals its length; snout 3; eye $2\frac{4}{5}$; mouth $1\frac{1}{4}$; width of mouth $1\frac{1}{5}$; interorbital space, measured from eye-sockets, 5; fore limb 2 in head and trunk; head and trunk $1\frac{1}{3}$ in hind leg. Body rather elongately ellipsoid, profile as viewed above with bulge about midway in head and trunk combined. Form rather robust, or with more or less ellipsoid trunk, and rather well depressed above and below, with convex surface. Pelvic bones forming obtuse angle in profile before last third of

length of head and trunk, though processes not especially elevated. Head moderate, broad, well depressed above and below, though anteriorly a little convex. Snout broad, largely convex above, its length about half its width, and when viewed above with rather narrowly convex profile. Eye elongate, rather large, well elevated, and placed over $\frac{4}{7}$ length of gape or about first $\frac{3}{5}$ in space between tip of snout and shoulder. Mouth large, gape straight and horizontal. Lips thin and upper overlapping edge of mandible all around when mouth is closed. Lower lip rather firm. When viewed below mouth rather elongately triangular, and rather broadly convex at symphysis so that protruding profile of upper jaw is seen as less convex. Symphysis of mandible with a slight fleshy projection fitting into a corresponding depression in front of upper jaw above, and on edge of lip along each side of process of mandible a slight indenture. Teeth in upper jaw fine, short, in a narrow band, better developed anteriorly, and more or less concealed. No mandibular teeth, edge firm. Vomerine teeth in 2 small closely approximated patches convergent posteriorly, and placed a trifle behind line between inner nares. Tongue large, ovoid, with bulge posterior, and posterior margin with a deep incision. Surface finely papillose. Sides and posterior part of tongue free. Internal nares placed a little further apart than outer. External nostrils conspicuous above on side of snout in front, much nearer its tip than eye, and internasal space a little greater than bony interorbital width. Internasal and interorbital spaces nearly evenly level. Loreal region slightly concave. Tympanum rounded, a little longer than deep, close behind and partly below level of eye, and its horizontal diameter about $\frac{3}{4}$ of eye-socket horizontally. Skin smooth over most of body, back, especially sides from after tympani, and dorsal surfaces of femoral and tibial regions more or less granular or papillose, though most coarsely so on costal region. No glandular folds on back. A slight keel from below external nostril back, till below tympanum. A groove, narrow and well defined, extends from posterior margin of eye back over tympanum, and then down to posterior boundary of vocal vesicle. Vocal vesicles large and capable of considerable inflation. Fore limb inserted

about $\frac{3}{7}$ in length of head and trunk, comparatively large, short and robust, and when appressed reaches beyond insertion of hind limb, though not to vent. Fingers 4, large, slender, attenuated, first more swollen at base than others, barely webbed, and upper surfaces more or less depressed. Third finger longest, about $2\frac{1}{2}$ in rest of arm, and first but a little shorter. Fourth finger shortest, and second but little longer. A small tubercle at each articulation of phalanges on lower or under surface. Carpal tubercles indistinct, though inner inferior portion of first digit with large padded area. Hind limb moderately long, rather robust, and femoral region about equals tibial. Space between tip of fourth toe and heel about equal to rest of leg measured to vent. Fourth toe longest, slender, and measured to incision of longest web, $6\frac{1}{3}$ in rest of limb to vent. Web of hind limb extending on fourth toe all space, except 2 terminal phalanges. Webs well developed on other toes leaving only terminal phalanges free. Tubercles at articulations of phalanges on fourth toe 4, 3 on fifth and third, 2 on second, and 1 on first. Third and fifth toe subequal, longer than others, except fourth, and first shortest. Cuneate tubercle rather small, though well developed, at base of first toe. Vent superior. Color in alcohol dull olivaceous-brown with slight traces of dusky or deep indistinctly defined spots or blotches. Streaks or shades on sides of body pale brownish. Lower surface of body pale creamy-brown, throat soiled with dusky, and belly indistinctly mottled with same. Under surface of hind limbs with coarse dusky-brown reticulations. Feet brownish. Sides marked with dusky-brown. Iris slaty. Length $4\frac{3}{4}$ inches. No. 10,762, Academy of Natural Sciences of Philadelphia. Cotype of *Rana virgatipes* Cope. Mare Run, tributary of Great Egg Harbor River above May's Landing, Atlantic County. E. D. Cope.

On April 23d, 1905, Mr. Thomas D. Keim and the writer, while investigating the fauna of the Great Egg Harbor river, obtained a number of specimens of this interesting frog, and were fortunate enough to learn something of its habits. The species seems to have been obtained on but 2 other occasions since it was first found by Cope in October of 1891. Mr. Witmer Stone

secured one on Shoal Branch of Wading River, near Speedwell, June 20th, 1901, and on May 31st, 1905, Mr. Paul Lorrilliere obtained 1 on a branch of the Batsto River near White Horse. All the above specimens, as well as Cope's types, are now in the collection of the Academy, making a series of 32 examples. Our specimens were obtained at the mouth of Mare Run, the type locality, and we noticed no other amphibians in this vicinity. Associated in this locality were many examples of *Chrysomys picta* and *Chelopus guttatus*, which were constantly bobbing about in the sphagnum. *Enneacanthus obesus*, *Mesogonistius chætodon*, *Erimyzon sucetta oblongus* and *Notropis chalybæus abbotti* were also abundant. The frogs seemed to occur exclusively in the almost submerged masses of sphagnum which line the shores in many places, and often extend well out in the stream. Here the water is still and the animals rest more or less below, so that their dull colors harmonize well with the surroundings. They were shy and sank quickly out of sight among the aquatic vegetation on the approach of danger. In attempting to escape they would not jump or leap, and when caught in the dip-net moved about in a rather slow stupefied manner. They swam for short distances, but were usually able to find suitable shelter close at hand. The individuals obtained by Cope and Stone did not make any noise, but when we discovered ours the males were in full cry, which would seem to indicate that late April was the height of the nuptial season. The males are provided with distensible vocal vesicles, and when about to utter their call these sacs are inflated like little bladders till nearly spherical, and then by degrees the air is allowed to escape. This gives the sacs the appearance of collapsing by a series of jerks. As it is done quickly, each jerk at an interval of a second, the result is a sort of rapping sound. These raps, or jerks, are about 5 or 6 in number. The sound produced is peculiar in that it is difficult at times to detect its source, and if the frog is close is quite startling. This is due not only to the suddenness, but also to the volume of sound. On one occasion an example which I captured had his vocal vesicles well inflated, and though they partly collapsed as I held him in my hand he did not utter any sound. The call bears

considerable resemblance to the noise produced by woodchoppers cutting trees a short distance back in the forest, and it is different from the cry of any other amphibian, so that when first heard I suspected it was produced by this species. In life the general color of the body is muddy-brown above. The lower surface is whitish, with a very diluted tint of dull yellowish in some examples. This was especially noticeable on the lower surface of the head and the fore feet. Side of head brownish. A pale brownish line from behind each eye back toward hind leg, distinct at first, but fading out gradually behind. Edge of upper jaw of same color, though with bronzed reflections in some examples. This color is then continued back as a line from below tympanum to groin. Along the flank it is a little paler and sometimes a little broader than the streak above. It serves to separate similar tinted or blackish-brown blotches of the lower surface from the color of the back. Back variegated with obscure blackish blotches nearly as large as pupil, and the same on the upper surface of the legs. Lower surface of legs with blackish-brown variegations, which also extend on the belly, and flanks below, though they vary greatly. Feet dusky, membranes of hind toes with blackish blotches. Tympanum and iris beautiful bronzed-brown, a narrow ring of bronze encircling pupil. Considerable variation as to color is observed in the large series of examples before me. This is striking in the color-markings of the lower surface and is to be found in both sexes. Some examples have the dusting of the throat more intense or dark, some nearly white, and in others it is variegated with diffuse blotches of blackish-brown like those on the breast. The same is true of the markings of the other lower regions, though they do not have the dusted appearance. In the case of 2 large females the markings on the under surface of the hind legs are very pale. Though there is a great variation in the extent of the dark coloring of the lower surface, the general character of the markings is always retained. No two individuals are alike and the hind legs sometimes differ from one another. Two of Cope's examples are a little smaller than any of mine, though both are more or less mottled or blotched on the belly. As this seems to be the case with all of my smaller or

medium-sized examples, I suspect it to be a character associated with youth. The style of the coloration of the upper parts is less variable. In some living examples I noticed here and there one a trifle pale, or with paler streaks, or the upper jaw more bronzed. The lower lateral streak from below the tympanum appears to vary also, as it is either ochraceous, dull reddish, brownish, olivaceous or whitish. Some variation may also be noticed in the skin. Some have the dermal papillæ rather more scattered than others. These are usually the smaller individuals, as the larger ones have a somewhat warty appearance. Mr. J. A. G. Rehn informs me he heard this frog at Cedar Grove, on the Oswego River, or the east branch of the Wading River, and also at Speedwell, during June of 1905. A description of the cluck of a frog, which may possibly have been this species, was given to me by Mr. G. Z. Hartman, of Palermo, Cape May County, who says that the frogs are common about the Cedar Swamp Creek region. Although diligently searched for in all suitable localities, I failed to discover any. Mr. Chreswell J. Hunt informs me that he noted this frog while camping on the dam of the Rancocas Creek at New Lisbon, in Burlington County, on the night of May 15th, 1906. During all of the evening its voice was the sound most in evidence. It was also abundant at the dam at Brown Mills on May 16th. About the shores at the head of these ponds were masses of sphagnum and in these spots the frogs seemed to abound. Although unsuccessful in securing specimens, he feels certain of the identity of the species, as the croak was so different from that of any other with which he was familiar. He also states that he did not hear it anywhere along the Rancocas below New Lisbon, which is well among the pines. During the past summer he heard it at Whiting. On May 30th, 1907, Mr. Paul Lorrilliere reports he heard this frog at Dennisville in Cape May County. The accompanying figures to this species show a female at the left. The 2 middle figures are dorsal and ventral views of males with distended vocal vesicles, and the right is a more usual type of coloration of the male. It has the vocal vesicles collapsed. In "The Frog Book" by Mary C. Dick-

erson the statement is made that this frog "was first discovered by Cope, at Atlantic City," which is entirely erroneous as Mare Run is some miles distant. Further, "in the summer of 1905 it was reported as very abundant near this type locality," is also wrong, as it was taken *at the type locality* by Mr. T. D. Keim and myself. This confusion is probably due to the fact that the type locality is in Atlantic County.

Rana virgatipes Cope, Am. Nat., XXV, 1891, p. 1019.—Davis, Am. Nat., XXXVIII, 1904, p. 893.—Fowler, Proc. Acad. Nat. Sci. Phila., 1905, p. 662, Pl. 40.—Davis, l. c., XXXIX, 1905, p. 795.—Stone, Am. Nat., XL, 1906, p. 164.—Dickerson, Frog Book, 1906, p. 222, Pl. 13, fig. 3 (2 figures).—Davis, l. c., XLI, 1907, p. 49.

***Rana catesbelana* Shaw.**

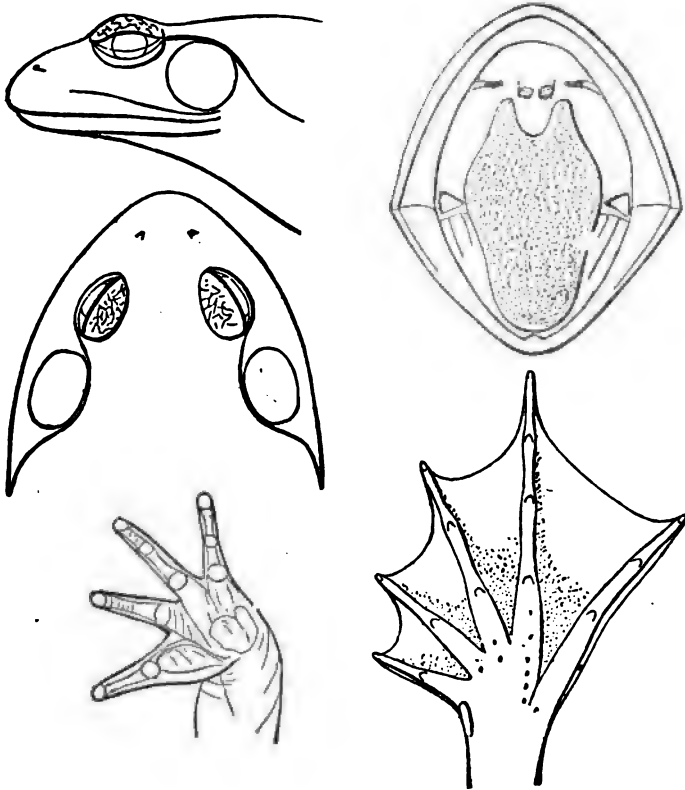
PLATE 27.

Bull Frog.

Jug-O'-Rum. Bloody Nouns. Bully.

Head, measured to posterior edge of tympanum, $2\frac{4}{5}$ in body to end of trunk, not including hind limb; depth about 2, apparently normal; greatest width of body about $2\frac{1}{6}$; width of head at posterior margins of tympani a little greater than its length; snout $2\frac{2}{5}$; eye $3\frac{2}{3}$; mouth but a trifle less than head; width of mouth a little greater than head; interorbital space, measured from eye-sockets, about 5; fore limb a little less than half of head and trunk; head and trunk about $1\frac{1}{2}$ in hind leg. Body bulky, robust, clumsy, rather elongately ellipsoid as viewed above with bulge about costal region, and constriction about evenly convex anteriorly and posteriorly. Form slightly depressed above and below, with most all of surface more or less convex. Pelvic bones forming an obtuse though rather abrupt angle about $\frac{3}{5}$ in length of head and trunk, and processes rounded convexly, not elevated. Head large, broad, greatly depressed both above and below, though with former surface more or less convex. Snout,

short, broad, convex above largely, its length about $2\frac{1}{2}$ in its width, and when viewed above with end but slightly narrowed convexly, though sides sloping gradually and evenly convexly back. Eye large, elongate, slightly elevated over upper profile, placed a little nearer tip of snout than shoulder or but a trifle behind middle in gape of mouth. Mouth large, gape nearly straight or but slightly undulated in profile. Lips fleshy and firm, upper



Bull Frog. *Rana catesbeiana* Shaw.

better developed, and closing over lower all way around. Lower lips more firm than upper with fleshy process at symphysis fitting in above. When viewed below mouth seen more broadly convex, though slightly more constricted than edge of upper profile, which protrudes well in front. Teeth small, conic, pointed, even, uniserial and better developed anteriorly, in upper jaw.

No mandibular teeth, edges of jaw hard and firm. Vomerine teeth small, in 2 closely approximated patches with front margins midway between and level with middle of internal nares. Tongue large, fleshy, thick, elongately ovoid with posterior margin deeply notched medianly, leaving a pair of long fleshy appendages directed down throat, and surface entirely papillose. Internal nares large, in transverse pits, and placed a little further apart than exterior. External nostrils rather slit-like, on outer front of snout and midway between its tip and eye. Internasal space a little greater than bony interorbital. Both internasal and interorbital spaces flattened. Loreal region slightly depressed concavely. Postero-infraorbital region depressed concavely. Tympanum moderate, slightly oval, a trifle less than eye, placed behind with lower half below eye, its anterior $\frac{2}{3}$ in front of rictus, smooth exteriorly, and more or less finely granulated medianly. Skin more or less smooth, papillose, or somewhat granular about lower and posterior edge of tympanum, postero- and supero-femoral and anal regions. Supero-costal region more or less obsoletely warty, and all about and below this region finely wrinkled. Under surface of body perfectly smooth. A fold of skin, bounded by a groove below, extends from canthus of eye back over tympanum and then curving around it extends down behind rictus to shoulder. It then passes around insertion of fore limb and is lost on breast. No other folds. Fore limb inserted about first $\frac{3}{8}$ in head and trunk, comparatively large and robust, and when appressed reaching a trifle beyond insertion of hind limb, or falling well short of vent. Fingers robust, 4, rounded, slender, not webbed, a little swollen at bases, and upper surfaces convex. Third finger longest, about 2 in rest of arm, first but a trifle shorter, second shortest, and fourth but a trifle longer than it. Tubercle at base of first finger small. On under surfaces of fingers at articulations of phalanges, tubercles 3 on third and fourth, though median less developed, and first and second each with 2, median there absent. Hind limb long, rather robust, femoral and tibial about equal, and rest of limb about equal to their combined length measured to vent. Fourth toe long, slender, and when measured to base at carpus $\frac{2}{3}$ to

heel. Toes broadly webbed, web extending on to distal phalanges, and outer edge of each external with a narrow fleshy keel. Fourth toe longest, third and fifth subequal, and next in size, and first shortest. At each articulation of phalanges on lower surface a tubercle, also at tip of each toe. Inner cuneate tubercle at base of first toe well developed. Vent superior. Color in alcohol dull muddy-brown above, back irregularly blotched with light chestnut-brown, and blotches becoming more or less indistinct and obsolete on top of head. Edge of upper jaw broadly olivaceous-gray. Tympanum brown with a slightly dusky center. Iris pale slaty, upper eyelid brownish like back, and lower dull creamy like belly. Upper surfaces of limbs colored like back, though all blotched with dusky-brown. Sides of body spotted indistinctly with color like belly. Lower surface of body pale creamy-brownish, limbs more or less soiled with brownish-dusky. Throat more or less soiled with same. Feet pale brownish. Webs of toes gray-brown. Length $12\frac{3}{4}$ inches. This example from Lenola. Dr. H. A. Pilsbry.

Color in life of a small example from Trenton Junction taken in October of 1906. Generally muddy-brown above, becoming grass-green on snout and head more or less. This shade most intense, or bright, around edges of mouth. Upper surface of all more or less tinted olivaceous in some lights, and in others a coppery tinge, especially around pelvic region. Tympanum grass-green. Posterior edges of both lips narrowly dusky. Iris beautiful dark golden finely sprinkled with dusky or blackish. Pupil black. Markings on upper surface of limbs and trunk obscure dusky-olivaceous, not well defined, and producing a more or less mottled appearance, or of small obscure mottled areas. Femoral region blackish, sprinkled above with pale tint of back and below with whitish, leaving a beautiful series of large irregular whitish blotches. Palmation of hind limb dusky-black, tubercles pale. Lower surface of all of hind limbs white like abdomen, and sprinkled with dusky blotches or spots of more or less irregular size which fade out on lower femoral region. Inguinal region blackish with light spots, and others also extend along in brownish of costal region. Lower surface of fore limb

white, margined broadly posteriorly with blackish or dusky. Throat whitish with dull or light greenish-olive cloudings producing a soiled appearance. Fingers dusky below, tubercles pale, with pale streak inside of each. Webs of hind legs dull olive-gray, with longitudinal darker pencillings.

Dr. Abbott says it was formerly more abundant about Trenton, and as they were in demand for restaurant purposes have probably been greatly diminished for that reason. They inhabit shallow open water, ponds, pools and small lakes, among *Nymphaea* and *Nuphar* beds, though at times they are met with in the upland swamps. In size they generally reach about 8 inches, when squatting. Dr. Abbott noted one of about this size which had swallowed a water snake, *Natrix sipedon*, which in turn had tried to swallow a meadow mouse. The snake was about a foot in length, and the mouse young. The bull frog varies greatly in color, some being very dark or dusky-olive, and others light or bright green. Many are mottled dusky. The smaller ones are apt to be more green, but not especially variegated. Some of those which were taken in the debris of springs during winter were semitorpid. This frog was reported by Mr. G. Z. Hartman to occur in the fresh-water ponds at the edge of the salt-marsh at Palermo, in Cape May County. Occasionally it will croak a short time in the fall as in the spring. It is found along the Rancocas Creek at various localities. The specific name here adopted is exactly as given originally by Shaw, which has been amended to *catesbiana* by most writers.

Rana catesbiana Abbott, Nat. Rambles, 1885, p. 476.—Sherwood, Proc. Linn. Soc. N. Y., 1897-98, No. 10, p. 23.—Stone, Am. Nat., XL, 1904, p. 163.

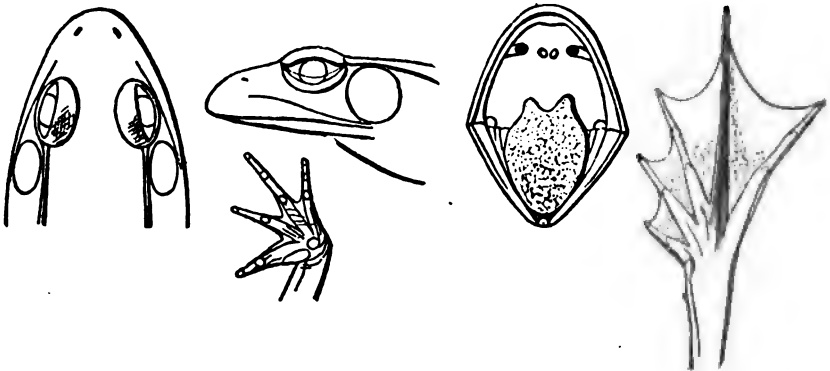
Rana pipiens Holbrook, N. Am. Herp., III, 1838, p. 81, Pl. 15 (ref. infers).—Holbrook, l. c., Ed. 2, IV, 1842, p. 77, Pl. 18.—Abbott, Geol. N. J., 1868, p. 804.—Abbott, Am. Nat., XXIV, 1890, p. 188.

Rana clamata Daudin.

PLATE 28.

Green Frog. Spring Frog. Bawling Frog. Yellow Throated
Green Frog. Belly Bumper. Bull Frog. Bully.

Head, measured to posterior edge of tympanum, $2\frac{1}{2}$ in body to end of trunk, not including hind limbs; depth about $2\frac{3}{5}$, apparently normal; greatest width of body about 2; width of head at posterior margins of tympani equal to its length; snout $2\frac{3}{4}$; eye $2\frac{3}{4}$; mouth $1\frac{1}{8}$; width of mouth $1\frac{1}{8}$; interorbital space, measured from eye-sockets, $5\frac{3}{5}$; fore limb about half of head and trunk; head and trunk $1\frac{1}{2}$ in hind leg. Body stout, robust,



Green Frog. *Rana clamata* Daudin.

massive, rather elongately ellipsoid as viewed above, and greatest width about midway in length, so that constrictions are more or less evenly convex anteriorly and posteriorly. Form but slightly depressed above, and that over median area which is somewhat leveled, sides sloping rather abruptly up. Lower surface more depressed or flattened. Pelvic processes forming an abrupt angle about $\frac{5}{8}$ in length of head and trunk, and processes rather conspicuous and protruding somewhat. Head rather large, elongate, well depressed both above and below, though with former surface more or less convex on sides, sloping up rather abruptly. Snout broad, depressed above, surface more or less convex, and its length about $1\frac{2}{3}$ in its width. When viewed above profile of snout slightly attenuated convexly in front, with sides sloping

evenly and gradually back from tip. Eye large, elongate, well elevated in profile, placed a little nearer tip of snout than shoulder or about over last $\frac{2}{3}$ of gape. Mouth large, gape more or less straight, or but slightly undulate, in profile. Lips fleshy, firm, upper better developed and closing over lower all way around. Lower lip more firm than upper, with slight fleshy knob at symphysis fitting in above. A single series of small, even and more or less concealed teeth in edge of upper jaw. No mandibular teeth, edges of jaw firm. Vomerine teeth minute, in 2 small closely approximated patches, just after level of middle of internal nares. Tongue large, fleshy, thick, elongately ovoid, bulge posterior, posterior margin deeply notched medianly, leaving 2 well-developed fleshy appendages directed down throat, and surface finely papillose, also porous. Internal nares a little further apart than external nostrils. Internal nostrils small, on outer front of snout and further apart than bony flattened interorbital areas. Loreal region depressed concavely. Tympanum large, equals eye-socket, rounded, circular, close behind with about lower third below eye, and rictus falling about half way in its length. About central third elevated in a shallow prominence, and its surface barely granulated. Skin more or less finely wrinkled or mammillated, and slight tubercles on sides. A lateral glandular fold extends back from eye, convergent posteriorly towards vent. This fold bifurcates over tympanum above and passes down along its posterior edge to disappear at shoulder. A firm elevated keel extends from below loreal region back till below middle of tympanum. Fore limb falls near first $\frac{3}{7}$ in length of head and trunk, comparatively robust, and when appressed reaches a little beyond groin, though not back to vent. Fingers rather slender, and not much enlarged towards bases. Third finger longest, about 2 in rest of arm, first a little shorter than third, and second and fourth subequally much shorter. Hind limb long, rather slender, femoral and tibial regions about equal, and rest of limb about $1\frac{1}{3}$ in combined length of latter measured to vent. Fourth toe long, slender, and when measured to carpus $\frac{2}{3}$ of space to heel. Toes broadly webbed, extending on to distal phalanges except that of fourth, and outer edge of each with a narrow fleshy keel. Fourth toe longest, third and fifth subequal

and next in size, and first shorter. At each articulation of phalanges on lower surface a tubercle, also at tip of each toe. Inner cuneate tubercle at base of first toe small. Vent superior. Color in alcohol dusky or blackish-brown above. Lower surface of body dull creamy-whitish or brownish. Lower surface of head and breast soiled brownish. Lower surfaces of limbs soiled dusky, like breast, and upper surfaces like back. Iris slaty. Length $6\frac{1}{8}$ inches. Shoal branch of the Wading River at Speedwell, Burlington County. April 30th, 1904. Witmer Stone and H. W. Fowler.

About Trenton, Dr. Abbott says it is the most common frog in the tide-water meadows. It is called "belly-bumper" sometimes, on account of the noise or splash it makes when jumping into the water and uttering its characteristic cry of alarm. It is not affected by low temperature as much as our other species. In the Indian summer many have been heard uttering their rattling or vibrating cries, and occasionally as late as the middle of November. The only other species noted at such times is the *Hyla pickeringii*. Dr. Abbott did not note variation in color to any great extent in this species, but of the multitudes of examples which I have examined I find it to be most variable. It is in fact the one frog which may most easily be confused with *Rana virgatipes*, or the sphagnum frog. It may be distinguished from that species perhaps most readily by the color-pattern of the lower surface of the hind-legs. It frequents to some extent the same localities, though in habits differs, as it may frequently be seen entirely out of the water, on shore, or on the banks. Messrs. P. Lorrilliere and C. J. Hunt found a number of examples in a branch of the Batsto River, between Goose Pond and White Horse, in Burlington County, May 31st, 1905. The note, evidently of this species, was heard near the forks of Cedar Swamp Creek, in Cape May County, during April of 1906. Also several were seen in the same locality. Mr. T. D. Keim has found them along the Pensauken Creek and near Moorestown. Many examples from Swartzwood Lake in October of 1895 (S. N. Rhoads), West Branch of the Wading River at Speedwell on June 3d 1905 (Paul Lorrilliere), May's Landing in the spring of 1892 (S. N. Rhoads), White Pond

in. October of 1895 (S. N. Rhoads), Haddonfield in June of 1893 and September of 1894 (S. N. Rhoads), near High Bridge in Burlington County on June 19th 1901 (Witmer Stone and J. A. G. Rehn), Bear Swamp in Burlington County on June 17th 1901 (Witmer Stone and J. A. G. Rehn), Sussex County (S. N. Rhoads), Clementon in Camden County on May 14th 1901 (J. A. G. Rehn), between Harris and White Horse in Burlington County on August 13th 1902 (Witmer Stone and J. A. G. Rehn), and Braddock's Mills in Burlington County in July of 1902 (Witmer Stone).

Rana clamata Harlan, Journ. Acad. Nat. Sci. Phila., V, pt. 2, 1827, p. 336.—Harlan, Med. Phys. Res., 1835, pp. 101, 226.—Cope, Bull. U. S. Nat. Mus., No. 34, 1889, p. 419, Pls. 51 figs. 2-3, 75 figs. 19-23.—Cope, Am. Nat., XXV, 1891, p. 1019.—Sherwood, Proc. Linn. Soc. N. Y., 1897-98, No. 10, p. 22.

Rana flaviviridis Harlan, Med. Phys. Res., 1835, pp. 103, 220.

Rana fontinalis Holbrook, N. Am. Herp., III, 1838, p. 85, Pl. 16 (ref. infers).—Holbrook, l. c., Ed. 2, IV, 1842, p. 89, Pl. 21.—Abbott, Geol. N. J., 1868, p. 804.

Rana hariconensis Abbott, l. c.

Rana clamitans Abbott, Nat. Rambles, 1885, p. 476.—Stone, Am. Nat., XL, 1906, p. 163.

Rana palustris Le Conte.

PLATE 29.

Pickerel Frog. Yellow Legs. Poison Frog. Poison Bully.
Poison Bull Frog. Zebra Frog. Tiger Frog. Marsh
Frog. Grass Frog. Yellow Leg Frog.

Head, measured to posterior edge of tympanum, 3 in body to end of trunk, not including hind limbs; depth about 3, apparently normal; greatest width of body $2\frac{7}{8}$; width of head at posterior margins of tympani a trifle greater than its length; snout $2\frac{1}{4}$; eye 3; mouth about $1\frac{1}{6}$; width of mouth but a trifle less than head; interorbital space, measured from eye-sockets, about 5; fore limb but a trifle less than head and trunk; head and trunk about $1\frac{2}{3}$ in hind limb. Body depressed, rather broadly so both above and below, elongately ovoid as viewed above with

bulge about opposite tympani, which is also greatest width of body. Constriction posteriorly rather evenly though slightly convex towards groin. Form rather slender with depressed appearance. Pelvic bones form an obtuse angle about posterior third in length of head and trunk, and processes rounded convexly, not elevated. Head large, broad, greatly depressed both above and below, though with edges of former surface more or less convex, and sides not especially abrupt. Snout short, broad, depressed above posteriorly, its length $\frac{4}{7}$ its width, and when viewed above end rather obtusely convex. Eye large, elongate, slightly elevated over upper profile, placed about midway between tip of snout, and shoulder, or about last $\frac{2}{5}$ in



Pickerel Frog. *Rana palustris* Le Conte.

gape of mouth. Mouth large, and nearly straight, or horizontal. Lips fleshy and firm, upper a little better developed and closing all around or over lower. Lower lip firmer, with slight fleshy process at symphysis fitting in above. When viewed below mouth a little more obtuse in profile anteriorly than edge of snout, which protrudes well in front. Teeth in upper jaw uniserial, small, even, a little better developed anteriorly, and more or less concealed by lips. No mandibular teeth, edges of jaw hard and firm. Vomerine teeth small, in 2 small posteriorly approximated and rather closely situated patches midway between

elongately ovoid with posterior margin deeply notched and each lateral fleshy end moderately short, directed down throat. Posterior half and sides of tongue all free, its attachment being at symphysis of mandible. Internal nares large, nearly twice as far apart as bony interorbital space, and also much further apart than external pair. External nostrils prominent, falling a little nearer tip of snout than eye, and on upper sides of snout. Internasal space a little greater than bony interorbital area. Both internasal and interorbital spaces flattened. Loreal region with a depression. Tympanum rounded, behind eye, separated by space about $\frac{3}{5}$ diameter of same horizontally, its lower half falling below level of eye, and rictus falling about midway in its width. Width of tympanum a trifle less than its depth, its median surface a little roughened and outer area smooth. Skin all more or less finely punctured with minute depressions over 4 longitudinal glandular ridges of back, outer of which extends down from each eyelid above. On upper surfaces of hind limbs similar depressions, and a few on humeral region above, and ulnar region posteriorly. Lower surface all more or less with similar pits, though middle of throat more or less smooth. Sides of body and limbs largely smooth. Posterior femoral and ventral regions rather coarsely papillose, especially former, though becoming smooth gradually towards knee. An obsolete groove from canthus of eye back over tympanum above towards shoulder, and below eye another back under tympanum in same direction, though both these very obsolete. Fore limb inserted first $\frac{3}{5}$ in length of head and trunk, robust, when appressed reaching insertion of hind limb, or but little posterior, and far from vent. Fingers robust, 4, slender, cylindrical, rather swollen at bases, especially first, and upper surfaces a trifle depressed basally. Third finger longest, slender, about $2\frac{1}{2}$ in rest of arm, first next in size, or longer than fourth, and second shortest. Tubercle at base of first toe very large, $\frac{2}{3}$ its length, then a rather large median tubercle on palm, though larger than external at base of fourth digit. Fingers with a very slight web between bases. On under surface of each finger a tubercle at each joint and at extremity of each, 3 on

first, 2 on second, 3 on third and 3 on fourth. Hind limb long, slender, femoral region a trifle less than tibial with former measured to vent, and rest of limb $1\frac{1}{4}$ in combined length of former. Fourth toe long, slender, and when measured to base at carpus $\frac{2}{3}$ to heel. Toes broadly webbed, and web extending to all of distal phalanges except that of fourth toe. Outer edge of external and internal toe with a slight keel. Fourth toe longest, third and fifth subequal in size, and with others graduated down to first, which is shortest. At each articulation of phalanges on lower surface a small tubercle, also at tip of each toe. Arranged as 2 on first and second toes, 3 on third and fifth, and 4 on fourth. A small inner cuneate tubercle at base of first digit and small obsolete one at base of fifth. Color in alcohol deep slaty-gray above, sides and lower surfaces of limbs yellowish to orange-yellow, especially on hind legs. Back with 2 median rows of large irregular blotches, and another series at each side on slaty-gray ground-color. On costal region below these a series of rounded blackish blotches. Tympanum in blackish blotch extending back from eye. A blackish blotch on lore, 2 in interorbital region, and 1 on snout posteriorly above. Lips rather finely spotted with blackish, also breast, under surface of hind legs, and post-femoral region to some extent. A pale grayish streak along spotted area on side of upper lip. A black blotch on front of shoulder, 1 at elbow, another across fore arm, and palm yellowish blotched with black. Hind limbs barred above with blackish transversely, 3 over femoral region, 3 over tibial region, 2 over tarsus, and 3 over digits. Lower surface of hind legs mottled yellow and black. Webs of hind legs dusky-orange mottled with darker. Iris slaty. Length $5\frac{3}{8}$ inches. Kinkora Creek, tributary of the Delaware above Kinkora, in Burlington County. October 16th, 1906. Found in woodland by Dr. C. C. Abbott, T. D. Keim and H. W. Fowler.

Color of the above in life, above pale brown with coppery reflections, especially down to lateral folds on back. Blotches on back olive-brown. Fold along upper lip pale coppery-brown. Lower surface of body whitish, breast and chin spotted with blackish, shoulders underneath soiled dusky, also throat. Under

surface of limbs yellowish to orange-brown, deepest on groin. Fore limbs below soiled with dusky, above blotched with olive-brown. Fingers pale above, translucent below, and tubercles pale, otherwise with blackish markings. Spots on sides of body and groin black. Femoral region speckled with blackish, transverse blotches above olive-brown. On hind limbs below some small blackish spots. Webs of hind toes translucent olive with blackish specklings. Tympanum and iris coppery, speckled blackish.

Dr. Abbott says it is nearly as abundant as *Rana pipiens* about Trenton, and equally distributed, usually preferring the long grass. It does not appear gregarious like *R. pipiens*, but is usually more or less solitary. It takes the longest leaps of any of our species, and occurs about most any damp grassy place if the grass is rather long. It makes a long harsh or rather tremulous croak. I have examples from Bridgeton, White Pond in October of 1895 (S. N. Rhoads), and Haddonfield on September 2d, 1894 (S. N. Rhoads).

Rana palustris Holbrook, N. Am. Herp., I, 1836, p. 93, Pl. 14 (ref. infers).—Holbrook, l. c., Ed. 2, IV, p. 95, Pl. 23.—Abbott, Geol. N. J., 1868, p. 804.—Abbott, Nat. Rambles, 1885, p. 476.—Sherwood, Proc. Linn. Soc. N. Y., 1897-98, No. 10, p. 21.—Stone, Am. Nat., XL, 1906, p. 163.

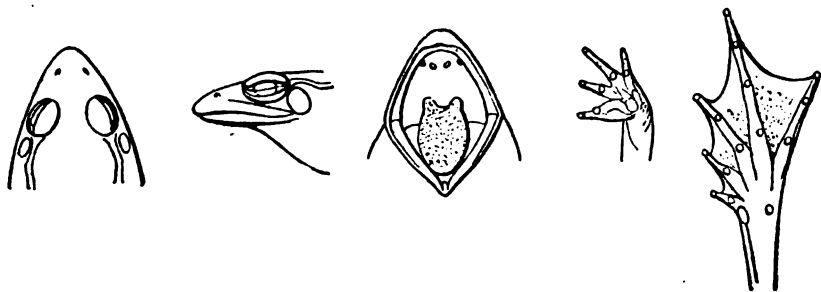
Rana sylvatica Le Conte.

PLATE 30.

Wood Frog.

Head, measured to posterior edge of tympanum, $2\frac{4}{5}$ in body to end of trunk, not including hind limbs; depth about $3\frac{3}{5}$ apparently normal; greatest width of body 3; width of head at posterior margins of tympani a trifle more than its length; snout $2\frac{1}{4}$; eye 3; mouth $1\frac{1}{8}$; width of mouth about equal to length of head; interorbital space, measured from eye-sockets, 4; fore limb a little over half length of head and trunk; head and trunk $1\frac{4}{5}$ in hind leg. Body depressed, rather broad, and slightly

ovoid as viewed from above, with greatest width at tympani. Constriction posteriorly slight. Form rather elongate and slender, and depression below greater than that above where sides are more or less abrupt, and median surface somewhat levelled. Pelvic bones forming an obtuse or rather abrupt angle about last $\frac{2}{3}$ in length of head and trunk. Processes rounded and not much elevated in profile. Head large, broad, greatly depressed both above and below, though former surface more or less convex. Snout depressed, its length $1\frac{3}{4}$ in its width, and when viewed above rather convergent triangularly, tip slightly rounded, and sides sloping evenly and convexly back to tympani. Eye rather large, elongate, slightly elevated over profile, placed nearly midway between shoulder and tip of snout, or about last third in length of mouth measured from tip of snout. Mouth



Wood Frog. *Rana sylvatica* Le Conte.

large, gape but slightly undulate in profile. Lips fleshy and firm, upper better developed, and closing over lower all around. Lower lip firmer than upper, with fleshy process at symphysis fitting in above. When viewed below mouth more broadly convex than edge of upper jaw which protrudes well in front. Teeth in upper jaw hidden by lip, uniserial, small, equal, and those in front of jaw larger than others. No mandibular teeth, edges of jaw hard and firm. Vomerine teeth very small, in 2 small widely-separated patches between internal nares, so that space between each is about same. Tongue large, rather thick, fleshy, elongately ovoid with posterior margin deeply notched medianly, leaving a pair of fleshy obtuse appendages directed down throat, surface entirely papillose, free more than half its length behind

and on sides to tip in front. Internal nares moderate, and a little further apart than external. External nostrils high, on sides of snout, and a little nearer eye than tip of snout. Internasal space a little greater than bony interorbital, and both a little flattened. Loreal region somewhat concave. Tympanum rather small, slightly ellipsoid vertically, close behind and about half of its diameter below eye. In size equal to about $\frac{2}{3}$ horizontal diameter of eye, and with smooth surface. Skin of upper and exposed portions of body and limbs more or less roughened by minute and close-pressed tubercles, with here and there a larger interspersed, and apparently not glandular or secretive. Largest and most prominent tubercles on sides and posterior portion of back. Posterior and inferior faces of thighs granulated about $\frac{3}{5}$ its length as well as small portion of belly and pubic region. Sides scarcely granulated, though rather distinctly pustulate. Rest of body below smooth. Skin pierced by innumerable fine pores. A fold of skin as a continuation of light stripe along edge of upper jaw extending back just above middle of arm and thickened behind. A rounded depressed fold begins at posterior end of eyelid and curves a little downward to tympanum, sending off a short branch along its posterior border, and then continues along side of body to insertion of hind limb. Fore limb inserted about first $\frac{4}{11}$ in head and trunk, well developed, fore arm shorter than hand, and comparatively robust. When appressed reaching a little beyond insertion of hind limb though not to vent. Fingers robust, 4, rounded, slender, conic or tapering from thickened bases, not webbed and upper surfaces basally rather convex. Third finger longest, about 2 in rest of arm, first but little shorter, second shortest, and fourth but a trifle longer than latter. On under surfaces of fingers a tubercle well developed at each articulation, 3 on first, 2 on second, 3 on third and 2 on fourth. Tubercle on palm medianly rather large and well developed, and one at base of each outer carpals evident. Hind limb long, slender, and tibial region a little longer than femoral as measured to vent, and their extended length a little more than rest of leg. Fourth toe long, slender, and when measured to base of carpus about $\frac{2}{3}$ to heel. Toes broadly webbed, web

extending on to distal phalanges except that of fourth toe, and outer edge of each external with a narrow fleshy keel. Fourth toe longest, others graduated down to first, which is shortest, with third and fifth subequal. At each articulation on lower surfaces of toes a tubercle, and 1 at each extremity. Inner cuneate tubercle at base of first toe well developed, also a small solar tubercle medianly. Vent superior. Color in alcohol pale gray-brown above, becoming more pale plumbeous tinted on sides. Sides of head below eye posteriorly, including tympanum, and extending back to an acute angle to a termination just above insertion of arm or posterior edge of maxillary fold, deep or rich blackish-brown. From side of tip of snout a blackish line to canthus of eye, and posteriorly continued along edge of dark tympanic partly to axilla. Edges of jaws brownish, lower paler, and both mottled, upper especially so anteriorly. A whitish streak from sides of tip of snout, becoming bright below and behind eye, extends back below dark tympanic patch to shoulder. Anteriorly mottled with brownish of upper lip. Lores gray. Lower surface of body yellowish-white, very obscurely soiled on breast. A few small pale dusky specks on side and back posteriorly. Across upper femoral region 4 gray-brown transverse bars, and posterior faces mottled with same color obsoletely, and brown forming ring around vent. Tibial and carpal regions with similar transverse bars, 4 on former, 2 on latter and 2 on digital region. Lower surface of hind limbs like belly. Fore limb of similar coloration, only bars across upper surface pale and few. Feet and hands brownish. From gape of mouth brownish extends down on front of shoulder. Iris slaty. Length $4\frac{3}{8}$ inches. Cedar Lake. October of 1895. Samuel N. Rhoads.

Others with same data. Besides these I have examined examples from Medford, in Burlington County, taken May 30th, 1905 (C. J. Hunt, and others by Witmer Stone), and Cedar Swamp Creek (E. D. Cope). About Trenton Dr. Abbott says it is not common in the upland. It is also found in the vicinity of streams though always in timber or woodland. It was found in woodland almost always in my experience, is a good jumper,

and while not largely aquatic, it swims well in the water. It often occurs in cleared woods and makes long leaps with ease. It is a beautiful animal in life, though varies much in the general tint of its coloration, sometimes nearly gray, and again others are found of nearly reddish-brown. In size I have not found it to exceed the pickerel frog.

Rana sylvatica Harlan, Journ. Acad. Nat. Sci. Phila., V, pt. 2, 1827, 338.—Harlan, Med. Phys. Res., 1835, pp. 103, 221.—Holbrook, N. Am. Herp., I, 1836, p. 95, Pl. 15 (ref. infers).—Holbrook, l. c., Ed. 2, IV, 1842, p. 99, Pl. 24.—Abbott, Geol. N. J., 1868, p. 804.—Abbott, Pop. Sci. Month., XXXIV, 1889, p. 165.—Sherwood, Proc. Linn. Soc. N. Y., 1897-98, No. 10, p. 23.—Stone, Am. Nat., XL, 1906, p. 163.

Class REPTILIA.

The Reptiles.

Limbs, when present, usually adapted for walking or sometimes for swimming, and embracing a single proximal element, 2 propodials, several mesopodials, metapodial and phalangeal elements. Basicranial axis ossified. Vertebral column consisting chiefly of centra. A distinct quadrate bone, or suspensorium of the lower jaw. Cerebral hemispheres larger than mesencephalon, whose moieties are fully exposed above and not laterally. Cerebellum small. Heart with 3 chambers. Aorta derived from 2 aorta roots, which consist of 1 or 2 bows on each side. Lungs cellular, functional. Gall-bladder, pancreas and fat-bodies present. Reproduction viviparous or ovoviviparous. Fertilization internal. Copulatory organs present. Embryo with amnion and allantois, and placenta none.

Cold-blooded air-breathing vertebrates usually scaly or covered with bony plates, never with feathers or hair. There is an incomplete double circulation of the blood, the septum between the 2 ventricles usually wanting or imperfect. There is no metamorphosis after leaving the egg, and the eggs are large and

mostly provided with a leathery skin. The skeleton is usually firm, and the nervous system is better developed than in the fishes and amphibians. The extinct forms are numerous, and show close relation with the earlier birds.

Key to the orders.

- a. Body covered with imbricated scales; dorsal vertebræ and ribs movable; bones of skull separate; jaws with teeth; vent a cross-slit.
- b. Mouth very dilatable; bones of mandible, and of head generally, united by ligaments; limbs wanting, or represented by short spurs on sides of vent; no shoulder-girdle; no eyelids; no tympanum. OPHIDIA
- bb. Mouth not dilatable; bones of mandible united by a bony suture in front; limbs 4, rarely wanting; shoulder-girdle present; eyelids usually present; tympanum usually present. LACERTILIA
- aa. Body short, depressed, enclosed between 2 bony or cartilaginous shields, or carapace and plastron, from which the head, limbs and tail may be protruded; jaws with a horny shield and no teeth; vent roundish or longitudinal, plaited. TESTUDINATA

Order OPHIDIA.

The Serpents.

Body elongate, terete. Mouth very dilatable, bones of both jaws and of the palato-pterygoid arch freely movable, united by ligaments only. Quadrate bone articulated to the skull. Brain-capsule entirely osseous. Tongue forked, capable of protrusion. No eyelids. No external ears. Limbs wanting. Shoulder-girdle wanting. Pelvic arch usually wanting, rarely rudimentary, and with hinder limbs represented by small spurs on the sides of vent. Vent a transverse slit. Copulatory organs present, paired. Body covered with imbricated scales which are shed as a whole and replaced at regular intervals.

The snakes may easily be distinguished from most of our other vertebrates within the limits of the state, by the absence of limbs.

Key to the families.

- a. Non-venomous; maxillary horizontal, not excavated; no deep pit between eye and nostril; upper jaw with solid teeth only, no grooved perforated fangs. COLUBRIDÆ

- aa. Venomous; maxillary vertical; a deep pit on each side behind nostril partly occupying excavated maxillary; upper jaws in front with large erectile perforated fangs, not grooved in front. CROTALIDÆ

Family COLUBRIDÆ.

The Colubrine Snakes.

Tail conical, tapering. No spur-like appendages to vent. Both jaws fully provided with teeth, which are conical and not grooved. No poison-fangs. Facial bones movable. Prefrontal not in contact with nasal. Transpalatine teeth present. Pterygoid extending to mandible, or quadrate. Supratemporal present, attached scale-like to skull and suspending quadrate. Maxillary horizontal, not movable perpendicularly to transpalatine. Mandible without coronoid bone. Head covered with shields. Belly covered with broad band-like plates, ventrally as gastrosteges, and sub-caudally as urosteges where they are arranged in pairs.

A very large family of very many genera and species, distributed over most of the globe, though most abundant in warm regions.

Key to the genera.

- a. Conic head not distinct from cylindrical and rather rigid body. CARPHOPHIOPS
- aa. Head more or less distinct from body, which is not especially rigid.
 - b. Rostral plate not recurved or keeled.
 - c. Anal plate divided.
 - d. Dorsal scales more or less keeled.
 - e. Nasal plates 2, with nostril between.
 - f. Loreal plate present.
 - g. Dorsal and lateral scales keeled; ventral plates 130 to 170.
 - h. Posterior teeth not the longer; scales transversely 19 to 21. REGINA
 - hh. Posterior teeth the longer; scales transversely 23 to 31. NATRIX
 - gg. Lateral scales not keeled; keels of dorsal scales often obscure; ventral plates 200 to 270; scales transversely 25 to 29. ELAPHE

- ff.* Loreal plate wanting; ventral plates 125 to 130; scales transversely 15 to 17. STORERIA
- ee.* Nasal plate single, pierced by nostril; loreal plate present
- i.* Nasal plate grooved; tail short; ventral plates 130 to 140; scales transversely 19. CLONOPHIS
- ii.* Nasal plate not grooved below nostril; tail very long, about $\frac{1}{3}$ of length; ventral plates 150 to 160; scales transversely 17. OPHEODRYS
- dd.* Dorsal scales not keeled.
- j.* Nasal plate single, pierced by nostril; loreal plate present; tail long; ventral plates 125 to 140; scales transversely 15. LIOPELTIS
- jj.* Nasal plates 2, with nostril between; loreal plate present; preocular plates 2.
- k.* Head depressed; preocular plates of nearly equal size; ventral plates 140 to 200 or more; scales transversely 15 to 17. DIADOPHIS
- kk.* Head not depressed; upper preocular plates much the larger, lower sometimes wanting; ventral plates 170 to 210; scales transversely 17. BASCANION
- cc.* Anal plate entire.
- l.* Dorsal scales all or partly keeled; head rather long.
- m.* Prefrontals 2 pairs, or 4 or more; ventral plates 200 to 250; scales transversely 25 to 35. PITUOPHIS
- mm.* Prefrontals 1 pair; ventral plates 140 to 180; scales transversely 19 to 21. THAMNOPHIS
- ll.* Dorsal scales not keeled, rather loosely imbricated; head short; ventral plates 160 to 240. LAMPROPELTIS
- bb.* Rostral plate produced, recurved and keeled; dorsal scales keeled; anal plate divided; head broad and short; some of posterior teeth enlarged; ventral plates 120 to 150; scales transversely 23 to 27. HETERODON

Genus CARPHOPHIOPS Gervais.

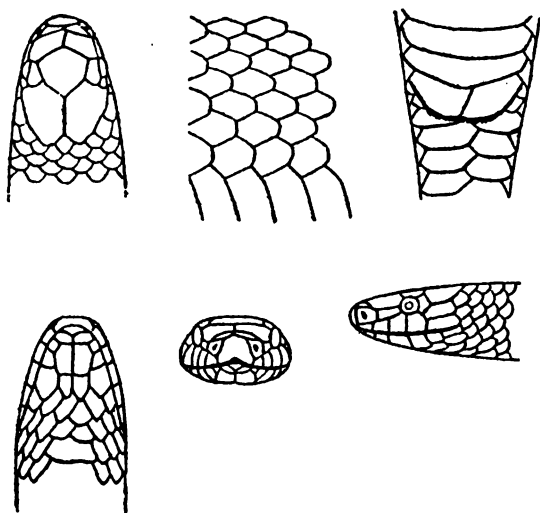
The Ground Snakes.

Carphophiops amœnus (Say).

PLATE 31.

Worm snake. Ground snake. Blind snake.

Head small, depressed, continuous with body. Snout broad, convexly depressed, and when viewed from above broadly con-

Worm Snake. *Carphophiops amœnus* (Say).

vex. It also projects well beyond mandible. Eye small, lateral and about midway in length of mouth measured from tip of upper jaw, or over commissure of third and fourth upper labials. Frontal plate unevenly hexagonal, shape of plumb-bob, nearly as broad as long. Internasals angular, about a third size of prefrontals, which are also angular, and touch upper front margin of eye. Parietals large, elongate. Rostral broad and well developed. Nasal single and nostril in middle of anterior half. Loreal large and touching front of eye. Postorbital elevated and quadrangular. Upper labials 5, and graduated back to

last, which is largest. Inferior labials 6, third largest. Temporal shields well developed, 2 in vertical row behind first temporal and last upper labial. Scales smooth, dorsal in 13 transverse rows and 164 to tip of tail. Outer row somewhat larger. Gastrosteges 127 to vent. Postabdominal plates double. Tail about $7\frac{1}{4}$ in length, robust and suddenly attenuated to a sharp horny point. Body very glossy with waxed appearance. Color in alcohol deep wax-brown above, lower surface pale immaculate creamy-white. Iris pale. Color when fresh above livid-brown, and reticulations formed by each scale scarcely if at all darker. Lower surface of body pale salmon-ochraceous, fading whitish in spirits. Line of demarcation along side of body distinct and pronounced. Labial plates pale and like lower surface of head. Iris brownish. Length $12\frac{1}{2}$ inches. This example taken from a fowl at Trenton, during June of 1906, by Dr. C. C. Abbott.

In the vicinity of Trenton it was formerly abundant, usually in woodland, according to Dr. Abbott. In 1868 his statements that "this common little snake is well known to farmers as having a decided predilection to dairies and cellars," and also "beyond the trouble caused by their fondness of milk, however, they are of no harm," evidently refers more correctly to his *Lampropeltis triangula* or *L. doliata*. This is more evident as he distinctly states that it is the "milk snake." It is apparently rare though possibly on account of its retiring habits among stones, logs, etc., may frequently be overlooked. I have examined examples from the above locality, others from Point Pleasant (Witmer Stone), Beesley's Point (Samuel Ashmead), and without definite locality from within our limits (Mr. Tiffany).

Coluber amœnus Harlan, Med. Phys. Res., 1835, p. 118.—Holbrook, N. Am. Herp., IV, 1840, p. 113, Pl. 23 (ref. iners).

Brachyorrhos amœnus Holbrook, l. c., Ed. 2, III, 1842, p. 115, Pl. 27.

Carphophiops amœna Abbott, Geol. N. J., 1868, p. 801.—Abbott, Nat. Rambles, 1885, p. 476.

Carphophiops amœnus Cope, Rep. U. S. Nat. Mus., 1898 (1900), p. 735.—Ditmars, Proc. Linn. Soc. N. Y., 1895-96, No. 8, p. 12.—Stone, Am. Nat., XL, 1906, p. 164.

Genus REGINA Baird and Girard.

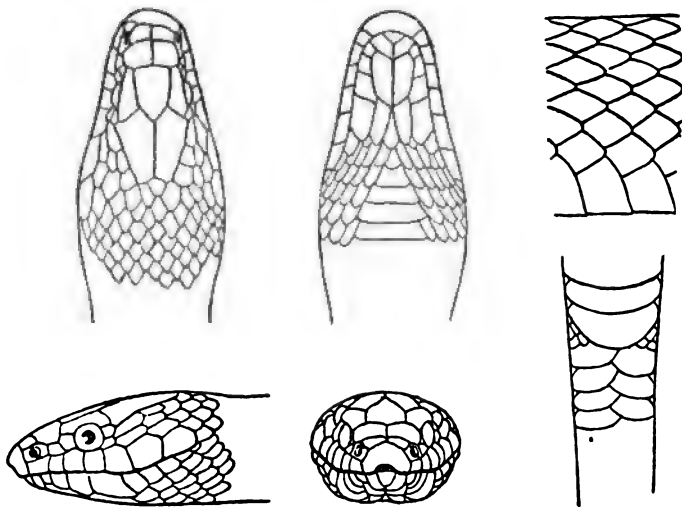
The Leather Snakes.

Regina leberis (Linnæus).

PLATE 32.

Leather Snake. Yellow Bellied Water Snake.

Scales all keeled, about 19 in a transverse dorsal series. Gastrosteges 140 to 150. Postorbital plates 2. Color chestnut-



Leather Snake. *Regina leberis* (Linnæus).

brown in life. A yellow lateral band and 3 narrow black dorsal stripes. Belly yellow with 2 brown bands. Length 24 inches.

I have not seen any examples from within the State. Holbrook stated it ranges into our limits, and is followed by Dr. Abbott, though it is possible that the latter's *Tropidonotus leberis* was an error for *Thamnophis saurita*. Dr. Abbott told me however that it was not common about Trenton, and is only found occasionally. It did not appear to him to differ much in habits from *Natrix sipedon*. It is said to live most of the time in the

water and only occurs on land about the banks of streams. It is harmless in its disposition.

Coluber leberis Holbrook, N. Am. Herp., IV, 1840, p. 105, Pl. 21.

Tropidonotus leberis Holbrook, l. c., Ed. 2, IV, 1842, p. 49, Pl. 13.—?Abbott, Geol. N. J., 1868, p. 802.—Abbott, Nat. Rambles, 1885, p. 476.

Genus *NATRIX*, Laurenti.

The Water Snakes

Natrix alpedon (Linnæus).

PLATE 33.

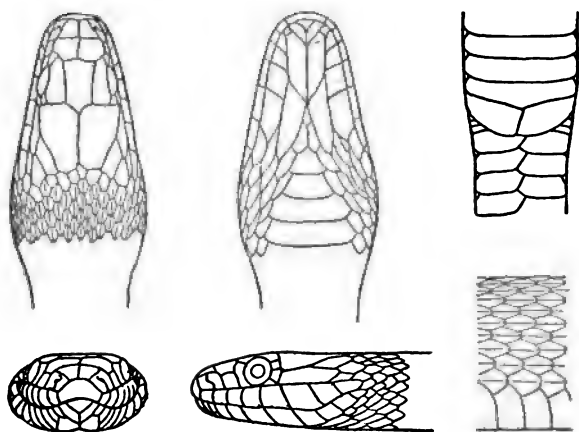
Water Snake. Brown Snake. Moccasin.

Water Moccasin.

Head depressed, ovoid when viewed above, tapering towards snout, and distinct from body, or with each side swollen. Snout depressed, its length $\frac{2}{3}$ its width, and sides sloping rather abruptly down on loreal regions. It also projects well beyond mandible. Eye moderately small, placed over commissure of fourth and fifth superior labial plates, and about half way in length of mouth. Frontal plate elongated pentagonally, and posterior angle obtuse. Internasals angular, with their convergence anteriorly approximated. Prefrontals broad. Parietals large, their convergence approximated posteriorly, forming an obtuse angle. Superciliaries narrow, forming 1 preorbital and 2 postorbitals. Loreal plate small, with side of prefrontal imposed above. Rostral broadly hexangular. Nasal large, nostril piercing center. Superior labials 8, forming convex ridge, and gradually enlarged to sixth and seventh. Inferior labials 9, fourth and fifth largest. Temporal shield touches postorbitals, and followed by 2 others. Scales on upper surface of body each with a well-defined median keel, those on sides more obsolete, especially lowest series. In transverse series over back 23 scales, and 112

from parietal plate to tip of tail. Gastrosteges 134 to vent. Post-abdominal plates divided or double. Tail about $5\frac{1}{4}$ in length, tapering rather robustly to tip. Color in alcohol deep dusky-brown above, becoming paler and more brownish on sides. Gastrosteges waxy with whitish streaks, and cuneate markings more or less dusky-edged. On posterior portion of body these all more or less soiled dusky like under surface of tail. Otherwise gastrosteges more or less tinted with pale chestnut. Iris pale. Length 37 inches.

Color of above in life, upper surface deep brown, obscurely marked with a slightly purplish sheen or bloom in some lights.



Water Snake. *Natrix sipedon* (Linnæus).

Brown extends on labial plates, though paler until about middle of side on trunk, line of demarcation distinct. Lower surface of body with a ground-color of waxy-white. About 38 transverse lateral dull umber bands on trunk, and 18 more on side of tail. These bands at first paler, then becoming more dusky or blackish, and each edge with same so that those on caudal and trunk posteriorly are more or less entirely diffused blackish. Sides of body and lower surface washed with pale terra-cotta, tinted brassy in some lights. Color below paler on thoracic region, and inclining to more ruddy tint posteriorly. Lower median surface of body with a series of blotches of terra-cotta color, at first

double or till about first third of length of snake in several irregular series, and then uniserial medianly to base of tail. These markings all more or less chevron-shaped at first, and all edged with dusky to blackish, or their edges mostly sprinkled with dusky to blackish dots. On lower surface of tail colors become more mottled. Iris dilute pale olive. Two of these snakes were found in a fresh-water pond at the edge of the salt-marsh at Palermo, April 15th, 1906, by G. Z. Hartman, T. D. Keim and myself.

Abundant, and usually found along the banks of streams or ponds where it can easily take refuge in the water. It is pugnacious, and if surprised or cornered, will strike wildly about, and though feared and immediately killed by most persons its bite is but a scratch. The adult attains on the average about a yard in length. It is a good swimmer and may frequently be seen swimming in considerable bodies of water. Here it feeds on fishes and will sometimes pursue and capture good-sized cat fish. It also will capture frogs, mice and toads. About Dennisville, in Cape May County, most persons seem to think 2 varieties of this snake occur, and it also is the case in some other localities. Usually one is described as reddish with dark blotches, and the other darker or more uniformly brown with obscure blotches. These are, I think, largely conditions of age. I have also observed it at Cape May about the fresh pools along the edges of the salt-marsh. Dr. Abbott says he found 1 at Lake Hopatcong which was between 5 and 6 feet in length, though the maximum size about Trenton is 4 feet. They feed on fish and frogs, and travel to the uplands, especially in the spring, though in the meadows they are the most abundant snake. When old they appear to become duller, only brightening in color somewhat as they shed the skin. In disposition they are savage and vicious. He also states that they have been known to bite the teats of the cows which fact has given rise to the belief that they have sucked them for the milk. This was known, however, only when the cows waded in the streams in warm weather to rid themselves of insect pests, or enjoy the refreshing cool water. A ball of about a dozen or more was reported in the mud in

spring-water, in February, which may have been hibernating. Many examples examined from Sea Girt in Monmouth County (S. N. Rhoads), Morris County (Dr. J. C. Fisher), Woodbury, Clement's Bridge (J. A. G. Rehn), Salem, and Beesley's Point (Samuel Ashmead). The young are abundant and differ very much from the adult in color. They are marked with distinct bright blotches. Persons, apparently reliable, have repeatedly informed me that they have seen the young to the number of a dozen or more quickly run into the mouth of the parent when disturbed, or frightened. I have not as yet been able to witness this performance.

Coluber sipedon Harlan, Journ. Acad. Nat. Sci. Phila., V, pt. 2, 1827, p. 351.—Harlan, Med. Phys. Res., 1835, p. 114 (copied).—Holbrook, N. Am. Herp., IV, 1840, p. 99, Pl. 19 (ref. infers?).

Tropidonotus sipedon Holbrook, l. c., Ed. 2, IV, 1842, p. 29, Pl. 6.—Abbott, Nat Rambles, 1885, p. 476.

Natrix dipedon Abbott, Geol. N. J., 1868, p. 802 (lapsus for *N. sipedon*).

Natrix sipedon Stone, Am. Nat., XL, 1906, p. 166.

Natrix fasciata sipedon Ditmars, Proc. Linn. Soc. N. Y., 1895-96, No. 8, p. 20.

Genus ELAPHE Wagler.

The Pilot Snakes.

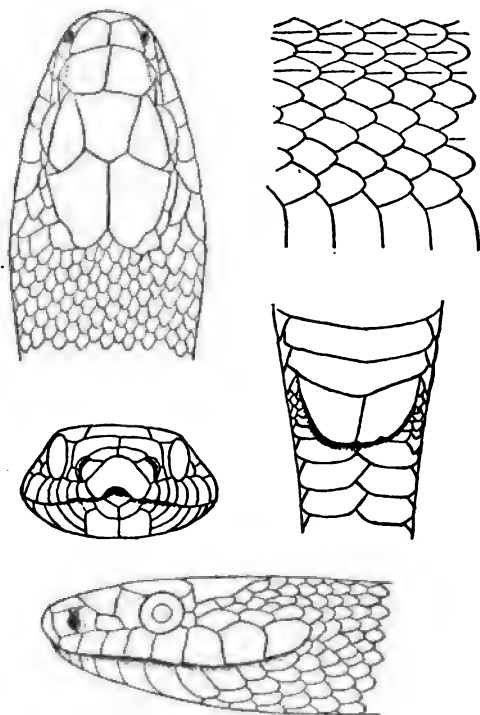
Elaphe obsoletus (Say).

PLATE 34.

Pilot Snake. Pilot Black Snake.

Body robust and tapering to both ends. Head small and scarcely distinct from body, constriction at neck very slight, and posteriorly sides little swollen in appearance. Snout obtusely convex, depressed, but slightly constricted anteriorly, its length about $1\frac{1}{4}$ in its width, and its sides rather abruptly vertical. Snout projects well beyond mandible. Eye moderately small, about mid-

way in length of mouth or over commissure between fourth and fifth superior labials. Frontal plate pentagonal, but a trifle longer than broad, anterior margin nearly straight, and posteriorly convergence ending in a right angle. Internasals rather broad, somewhat angular, and hardly more than half size of prefrontals. Prefrontals form a convex margin anteriorly, broad, and bending down over side of snout to meet loreal. Parietals large, broad,



Pilot Snake. *Elaphe obsoletus* (Say).

and convergence posteriorly broad with but slight median notch. Rostral rather large, triangular in form. Nostril large, piercing commissure between nasals about midway in its extent. Loreal trapezoidal, higher in front. Supraocular moderate, a little shorter than frontal, convergent anteriorly. Preocular rather large. Postoculars 2, subequal, and rather small. Upper labials 8, moderate, sixth and seventh largest, and eighth also large.

Lower labials 12, fifth and sixth largest. Temporal plates 2, small, and followed by about 3 more series of smaller ones. Scales all more or less smooth, median series down back slightly keeled, and keels disappearing progressively down sides of body. Scales in 22 series counted transversely over back, and 326 in a longitudinal series from parietal plates to tip of tail. Gastrosteges 210 to vent. Urosteges double. Tail about 5 in length of body, and rapidly tapering to a slender tip. Color in alcohol deep umber-brown, obsoletely variegated with about 40 or more deep brownish obscure blotches or saddles down middle of back. These blotches very ill-defined and of more or less nebulous appearance. On each side of this area a slightly pale streak extends longitudinally, and more or less speckled or mottled obscurely with brownish. Then below this another dark area colored like middle of back longitudinally, and also bounded below by another slightly speckled streak. Gastrosteges at first creamy-brown, but posteriorly and with urosteges becoming more or less obscure, with large blotches of slaty-brown or dusky. Anteriorly on body these markings are seen as lateral blotches extending on lateral edges of a pair of abdominal plates, then skipping 2 or 3. As they progress posteriorly inner slaty quadrate blotches alternate with their inner corners, which encroach more or less posteriorly on paler abdominal color though always leaving a median pale streak, sometimes largely of spots. On under surface of tail pale color vanishes altogether posteriorly. Labials, mandible and under surface of head, creamy-brown. Iris pale slaty. Length 60 inches. Stone Harbor, Cape May County. May, 1901. David McCadden.

This is the only adult example I have seen. Mr. McCadden tells me he secured it unawares, as it was coiled and basking, or napping in the sun. When seized in the hand it made considerable commotion, and was quite powerful in its contortions. Possibly the accounts of large black snakes credited to this region in former times may have reference to this species rather than to *Bascanion*.

A small example $13\frac{3}{4}$ inches in length, taken at Dennisville and received from Samuel Ashmead, is most likely the young of this species. Mr. Stone has recorded it as *Calopeltis obsoletus*

confinus, a form of which the type seems to have been lost, according to Cope, and which is also without definite locality. It is colored brownish-white generally, in alcohol, with about 44 deep brown saddle-like blotches down the back. Along the sides a series of similar-colored small blotches alternate, and each usually opposite a dorsal saddle. A second series of brownish blotches along each outer portions of gastrosteges, extending over 2 to 4 scales alternately, and more or less with a narrow median uninterrupted pale area entire length of body. At first these gastrostegial spots pale and not very pronounced, but gradually become deeper. Top of head pale brownish-white with an antero-orbital connecting dark brown band. A narrow dark brown band from lower margin of eye to rictus. Head otherwise pale brownish-white, save a few inconspicuous pale brown specks on parietal and frontal plates. Scales on back all more or less entirely smooth.

In Monthly Bulletin of the Pa. State Dept. Agric., IV, 1906, on Pl. 25, Prof. H. A. Surface gives a photograph of this interesting stage.

Calopeltis obsoletus Ditmars, Proc. Linn. Soc. N. Y., 1895-96, No. 6, p. 16.—Stone, Am. Nat., XL, 1906, p. 166.

Calopeltis obsoletus confinis Stone, l. c.

Genus STORERIA Baird and Girard.

The Brown Snakes.

Key to the species.

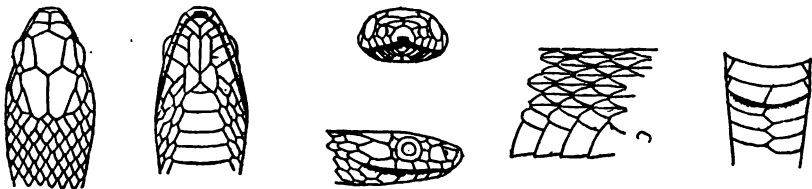
- a. Preoculars 2; postoculars 2; upper labials 5 or 6; no black spot below eye; belly usually red. OCCIPITO-MACULATA
- aa. Preocular single; postoculars 2; upper labials 7; a dark spot below eye; belly always whitish. DEKAYI

Storeria occipito-maculata (Storer).

PLATE 35.

Red Bellied Snake.

Body slender, tapering anteriorly, and cylindrical. Head a little distinct from body, and neck somewhat constricted. Form of head depressed, flattened more or less both above and below, and as viewed above rather broadly convex. Snout broad, depressed above, its length about $\frac{4}{7}$ its width, and sides rather abruptly vertical. Viewed above snout seen to be rather broadly convergent with edge obtusely convex, and profile also obtuse, projecting well beyond mandible. Eye rather large and placed over commissure of third and fourth upper labials. Frontal plate broadly subpentagonal, anterior margin scarcely angled,

Red Bellied Snake. *Storeria occipito-maculata* (Storer).

posterior obtusely angled, and sides straight with wide posterior convergence. Internasal rather large and subangular, more than half of prefrontals. Prefrontal rather large and broad, and bending down a little over edge of snout to postnasal. Parietals very large, broad, posteriorly convergent, and median notch posteriorly distinct. Rostral broadly lunate, scarcely impinging on anterior edges of internasals. Nostril largely on anterior nasal plate at internasal commissure. Postnasal larger than prenasal. No loreal. Supraocular elongate and rather widely convergent anteriorly. Preoculars 2, subequal. Postoculars 2, upper a trifle larger. Temporal long and followed by a series of 2 smaller ones. Upper labials 6, rather elongate, and fifth and sixth longest and largest. Lower labials 7, and fifth largest. Pregenials longer than postgenials. Scales on back strongly

keeled, and keels extending down on sides, more or less obsolete along lowermost series. Transversely over back 15 series of scales, and 163 counted from parietal plates to tip of tail. Gastrosteges 111 to vent. Tail tapering gradually to a slender point, about 4 in entire body. Color in alcohol uniform dull olivaceous-gray above. Sides of body along each outer portion of gastrosteges dull plumbeous-gray, finely speckled or dotted with dusky. Gastrosteges otherwise dull brownish-white. Along each side of neck anteriorly a deep dusky spot on outer portions of gastrosteges, which soon gives way posteriorly to specks in lateral streak. Lower surface of head grayish. Just behind parietal plates, and scales after second series of temporals, a series of 3 ill-defined creamy-white blotches over back of neck, 1 median at occiput and another on each side not interrupting grayish streak along side. Urosteges like belly in color, and line of demarcation along sides of tail very distinct. Iris pale slaty. Length $7\frac{1}{2}$ inches. Bear Swamp, Burlington County. November 1st, 1903. Witmer Stone.

The above described example is the only one I have seen. Dr. Abbott tells me it is common above Trenton, and was not found about his residence, but along the rocky portions of the Assanpink Creek. It is entirely harmless and inoffensive, and may usually be met with in dry woods on the ground. It is also variable in color, the white on the neck suggesting the ring neck snake.

Storeria occipitomaculata Ditmars, Proc. Linn. Soc. N. Y., 1895-96, No. 8, p. 22.—Stone, Am. Nat., XL, 1906, p. 164.

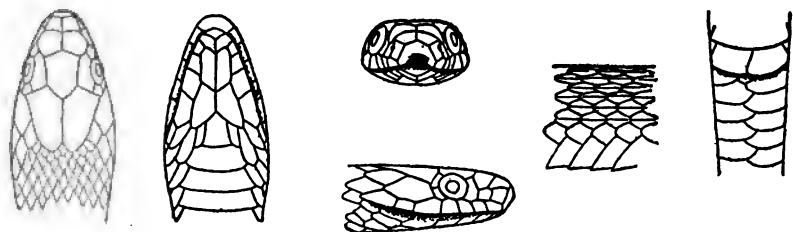
Storeria dekayi (Holbrook).

PLATE 36.

DeKay's Brown Snake. Brown Snake. DeKay's Snake.
Spotted Snake. Spotted Adder.

Head scarcely distinct from body or without constriction at neck, ovoid as seen above, and sides hardly swollen posteriorly. Snout rather obtuse, convex, its length about $1\frac{1}{3}$ in its width, and

sides rather abruptly vertical. When viewed above obtusely convex with rather broad convergence. Snout obtuse in profile and projecting well beyond mandible. Eye moderately large, and placed over commissure of third and fourth upper labials. Frontal plate hexagonal, broad, convergence rather broad posteriorly with straight sides, and posterior angle steeper than anterior. Internasals rather broad and somewhat angular, much more than half size of prefrontals. Prefrontals broad and bending over side of snout down to postnasal. Parietals large, rather elongate, convergence posteriorly moderate, and median emargination shallow. Rostral rather broadly crescent-shaped. Nostril pierces internasal commissure which separates 2 rather large nasals. No loreal. Supraocular narrow and long. Preocular single and large. Postoculars rather long, 2. Upper labials 7,



DeKay's Brown Snake. *Storeria dekayi* (Holbrook).

of which seventh is largest, and fifth larger than sixth. Lower labials 7, and fifth largest. Postgenials equal to pregenials. First temporal largest, wedged between parietal and last 3 upper labials, and followed by a row of 2 more. Scales on back strongly keeled, and keels becoming obsolete or lost at lowest lateral series, in 14 transverse series, and 185 between parietals and tip of caudal. Gastrosteges 124 to vent. Urosteges double. Tail about $3\frac{1}{2}$ in length of body, and narrowly attenuated to a sharp tip. Body rather thick in middle and tapering towards each end. Color in alcohol grayish-brown above, with a clay-brown longitudinal median dorsal line or band margined parallel on each side by brownish, and deep brown spots interspersed their entire length. On each side of these dark streaks a longitudinal dorso-lateral series of brownish spots. A deep brown shade on each

side of occiput. A blackish oblique bar crossing temporal plate posteriorly over commissures of last or sixth and seventh labials. A blackish blotch from lower margin of eye in commissures of third and fourth, and fourth and fifth labials. Head above dotted with deeper brownish than ground-color. Each of gastrosteges with brownish at each end and here and there a dusky dot in same locations. Iris slaty. Length $9\frac{5}{8}$ inches. May's Landing, in Atlantic County. Spring of 1893. S. N. Rhoads.

Rather abundant. Most examples which I have noted were found near towns where they do not appear to be especially disturbed by the encroachments of civilization. They may be frequently found under old tins and waste matter on old dumps. Their ability to successfully combat such conditions is probably due to their protective colors, small size, and reproductive powers. The disposition of this animal is usually mild and gentle, seldom assuming the offensive. It is entirely terrestrial, and though I have taken it about meadow or swampy land it was never in the water, and never even on very moist ground. Dr. Abbott says that in the vicinity of Trenton it is found in the meadows and heavy damp pastures. It is a fine swimmer and will take to the water when pursued, though not diving.

Tropidonotus dekayi Abbott, Geol. N. J., 1868, p. 802.

Storeria dekayi Abbott, Nat. Rambles, 1885, p. 476.

Storeria dekayi Ditmars, Proc. Linn. Soc. N. Y., 1895-96, No. 8, p. 21.—Stone, Am. Nat., XL, 1906, p. 164.

Genus CLONOPHIS Cope.

The Kirtland Snakes.

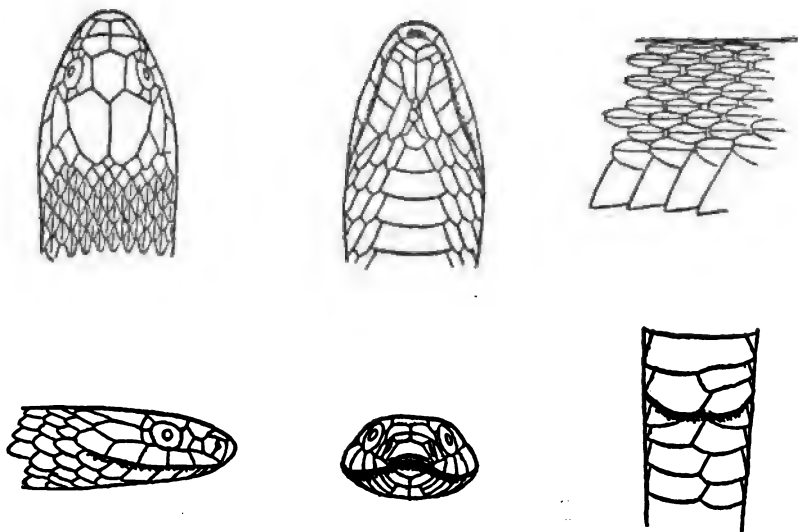
Clonophis kirtlandii (Kennicott).

PLATE 37.

Kirtland's Snake.

Head not distinct from body, depressed, and but scarcely swollen on sides posteriorly. Snout rather convexly depressed, its length about $\frac{4}{5}$ its width, and sides rather abruptly vertical.

When viewed above obtusely convex with convergence rather broad so that entire shape is seen as elongately ovoid. Snout also projects a little beyond mandible. Eye moderately small, placed about midway in length of mouth, or over commissure between third and fourth superior labials. Frontal plate hexagonal, longer than broad and slightly convergent posteriorly. Internasals rather broad, somewhat angular, and a little more than half size of prefrontals which are quadrangular and bend down over side of snout to loreal. Parietals large, rather elongate, and with broad convergence posteriorly. Rostral

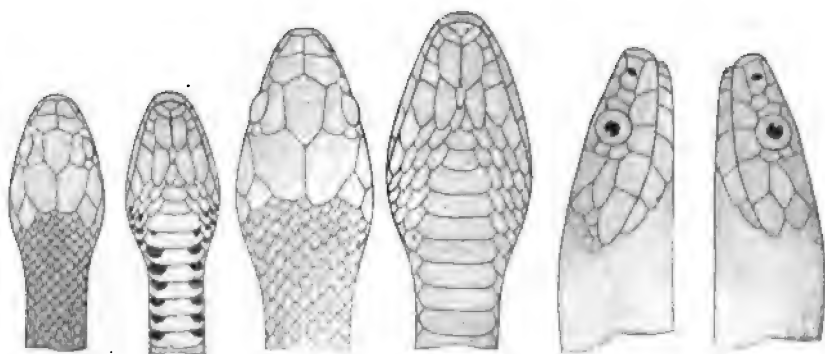


Kirtland's Snake. *Clonophis kirtlandii* (Kennicott).

moderately broad. Nostril pierces internasal commissure, which separates 2 nasal plates. Loreal small. Supraocular and preocular rather long, and former larger. Postoculars 2, small. Upper labials 6, last elongated, and fourth and fifth deepest. Inferior labials 7, fifth largest. Temporal long, and 2 others above posteriorly. Scales strongly keeled, dorsal in 19 transverse rows and 192 to tip of tail. Gastrosteges 130 to vent. Urosteges double. Tail about $4\frac{2}{3}$ in length of body, and narrowly attenuated to sharp tip. Color in alcohol faded pale sandy-brown, belly and under surface scarcely paler, though wax-like.

Down each side about 52 distinct deep brown blotches to vent, and a number of others continued along side of tail but apparently fading out posteriorly. At latter edge of each of gastrosteges a small brownish dot so that 2 well-marked series are seen when viewed below. A deep brownish streak along side of head includes eye in its course. Iris pale slaty-gray. Length $11\frac{1}{2}$ inches. Trenton. Dr. C. C. Abbott.

The above-described example is the only one I know of though another was seen which was not captured. It is said to be an inoffensive harmless species, but will show self-defense. It is



Kirtland's Snake. *Clonophis kirtlandii* (Kennicott).

also said to flatten itself so that it will appear very broad and thin. It appears to be sluggish and frequents woodland, generally under logs.

Tropidoclonion kirtlandi Cope, Proc. Acad. Nat. Sci. Phila., 1860, p. 340.—Abbott, Geol. N. J., 1868, p. 801.

Clonophis kirtlandi Stone, Am. Nat., XL, 1906, p. 164 (from Cope).

Genus OPHEODRYS Fitzinger.

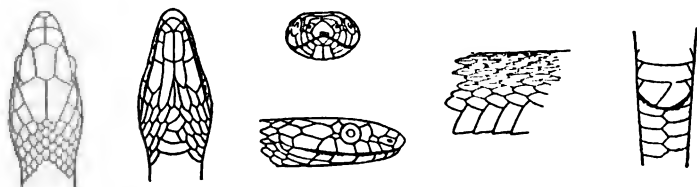
The Summer Snakes.

Opheodrys aestivus (Linnæus).

PLATE 38.

Summer Snake. Green Snake.

Head little distinct from body, though neck slightly constricted, well depressed, elongately ovoid as seen from above, with greatest width or bulge well posterior. Temporal region scarcely swollen. Snout broad, or about as long as broad, surface rather levelled or flattened, and as viewed from above rather conver-



Summer Snake. *Opheodrys aestivus* (Linnæus).

gent, with tip bluntly convex in front. Sides of snout rather steeply vertical with a depression in loreal region. Eye rather large, placed over commissure of third and fourth labials. Frontal plate elongately hexagonal, broad, convergent sides convex posteriorly, and angle most acute posteriorly. Internasals rather broad and large, and rostral scarcely impinging anteriorly. Prefrontals much larger, and like internasals with edges abruptly bent over sides of snout. Parietals large and rather broadly convergent posteriorly. Rostral broadly crescentic. Nostril pierces front of elongated nasal plate. Loreal plate large, subtrapezoidal. Supraoculars elongate, narrowly triangular, and surface convex. Preocular large, single, much broader above than

below. Postoculars 2, subangular, and lower smaller. Upper labials 7, with sixth largest. Lower labials 8, with fifth largest. Postgenials longest. Temporal elongate, and followed by a series of 2 scales with lower largest. Scales all well keeled over back, and keels becoming less elevated down sides, those in about first 2 series immediately above gastrosteges smooth. About 15 series of scales transversely over back, and 295 counted from parietal plates to tip of tail. Gastrosteges 152 to vent. Urosteges double. Tail about $1\frac{2}{3}$ in body, and very slender and whip-like towards tip. Color in alcohol olive-bluish or slaty on back, and median dorsal region darker than sides, which are more or less entirely with bluish tints. Under surface of body creamy-white. This color also extending anteriorly over lower surface of head entirely to inclusion of upper labials, and to tip of tail, though there more or less grayish tinted. Iris dull grayish. Length 27 inches. Braddock's Mills in Burlington County. July 26th, 1902. Witmer Stone.

Most frequently met with in the southern part of the state, though in my experience rather scarce. It is usually confused with *Liopeltis* and generally regarded as poisonous though of course quite harmless. Its food consists largely of insects. The green snake, evidently this species, is reported from Dennisville in Cape May County, where however it is said to be rare. Mr. McCadden found it at Cape May Court House.

Coluber æstivus Harlan, Journ. Acad. Nat. Sci. Phila., V., pt. 2, 1827, p. 357.—Harlan, Med. Phys. Res., 1835, p. 121.—Holbrook, N. Am. Herp., II, 1838, p. 119, Pl. 27.

Leptophis æstivus Holbrook, l. c., Ed. 2, IV, 1842, p. 17, Pl. 27.

Ophiodrys æstivus Cope, Proc. Acad. Nat. Sci. Phila., 1860, p. 560.—Abbott, Geol. N. J., 1868, p. 802.—Ditmars, Proc. Linn. Soc. N. Y., 1895-96, No. 8, p. 14.

Cyclophis æstivus Abbott, Nat. Rambles, 1885, p. 476.—Cope, Rep. U. S. Nat. Mus., 1898 (1900), p. 784.—Stone, Am. Nat., XL, 1906, p. 166.

Genus *LIOPELTIS* Fitzinger.

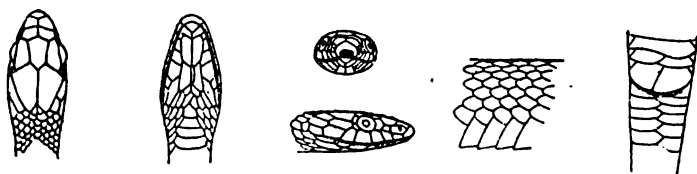
The Green Snakes.

Liopeltis vernalis (Harlan).

PLATE 39.

Green Snake.

Head little distinct from body, depressed, ovoid, and with temporal region slightly swollen. Snout rather obtusely convex in front, depressed somewhat, its surface more or less convex, its length about $\frac{3}{4}$ its width, and its sides more or less abruptly vertical. When viewed above convergence of snout seen as rather broad. Snout projecting well beyond mandible. Eye moderate, placed a little anterior in length of mouth or over commissure of

Green Snake. *Liopeltis vernalis* (Harlan).

third and fourth upper labials. Frontal plate elongately hexagonal, anteriorly with broad convergence and posteriorly narrowly so, each side slightly concave. Internasals broad, with rostral extending in between in front so as to form an obtuse posteriorly directed angle. Prefrontals much larger, quadrangular, and bending down over side of snout to loreal. Parietals large and rather broadly convergent posteriorly. Rostral moderately broad, and triangular as seen in front. Nostril pierces front of single elongate nasal plate. Loreal small, only present on left side. Supraoculars rather long, not especially convergent anteriorly. Preoculars and postoculars 2, latter a little larger. Upper labials 7, sixth largest. Lower labials 8, fourth largest. Temporal elongate, followed by 2 others. Scales

all smooth, without keels, in 15 transverse series over back, and 174 counted from parietal plates to tip of tail. Gastrosteges 125 to vent. Urosteges double. Tail about $3\frac{1}{2}$ in length of body, and slender, ending in a sharp tip. Color in alcohol plumbeous above, and whitish below. Iris plumbeous. Length 11 inches. Trenton. Dr. C. C. Abbott.

About Trenton it has been found in the second growth of timber, though not common according to Dr. Abbott. In life it is a beautiful animal, and is dark green above, becoming paler on sides, and lower surface yellowish-white. In the latter respect it may be easily identified from *Opheodrys aestivus*. It is perfectly harmless, and appears to be more of a member of the upland fauna.

Coluber vernalis De Kay, in Harlan, Journ. Acad. Nat. Sci. Phila., V, pt. 2, 1827, p. 361.—Harlan, Med. Phys. Res., 1835, p. 124 (copied).—Holbrook, N. Am. Herp., IV, 1840, p. 85, Pl. 15 (ref. infers?).

Liopeltis vernalis Cope, Proc. Acad. Nat. Sci. Phila., 1860, p. 560.—Abbott, Geol. N. J., 1868, p. 802.—Ditmars, Proc. Linn. Soc. N. Y., 1895-96, No. 8, p. 14.—Stone, Am. Nat., XL, 1906, p. 166:

Genus DIADOPHIS Baird and Girard.

The Ring Necked Snakes.

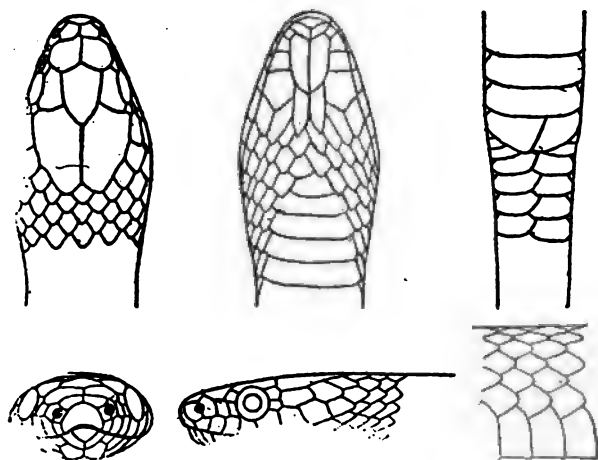
Diadophis punctatus (Linnæus).

PLATE 40.

Ring Necked Snake.

Body rather cylindrical. Head scarcely distinct from body, depressed, flattened above, obtusely ovoid as seen from above and with temporal region scarcely swollen. Snout depressed, broadly and obtusely convex as seen from above in front, its length about $1\frac{1}{3}$ in its width, and its sides more or less abruptly vertical. When viewed above convergence of snout seen to be slight, and its front projects well beyond mandible as seen in

profile. Eye rather small, placed a trifle anterior in length of mouth or over commissure of fourth and fifth upper labials. Frontal plate rather broadly pentagonal, constricted moderately behind with straight sides and posterior angle much more acute than anterior. Parietals broadly convergent posteriorly, with median emargination. Internasals small, scarcely overlapping edges of snout, and about half size of prefrontals. Prefrontals rather large and bending down over side of snout a little to loreal. Rostral large, and rather broadly crescent-shaped. Nostril pierces commissure of nasals, which are rather small, and 2 in number. Loreal rather large. Supraoculars small, rather



Ring Necked Snake. *Diadophis punctatus* (Linnæus).

broadly constricted anteriorly, and much shorter than frontal. Preoculars 2, upper rather broad, and lower a little long vertically. Postoculars 2, upper nearly twice size of lower. Upper labials 8, and seventh largest. Lower labials 8, fifth largest. Pregenials longer than postgenials. Temporal rather small, elongate, and followed by another a little smaller. Scales all smooth, without keels, in 15 transverse series over back, and 225 counted from parietal plates to tip of tail. Gastrosteges 146 to vent. Urosteges double. Tail about 4 in body, and tapering rapidly to a slender tip. Color in alcohol pale grayish above. Under surface creamy-brown with a deep brownish spot at each

end of gastrosteges, indistinct on side of neck at first, though gradually becoming more pronounced. A creamy-white transverse band on upper surface of head width of 2 scales, and in front and behind a deep brownish area annectant of about equal extent, and fading off gradually in ground-color of body. First or anterior of these patches continued forward to include eye, and around side and front of snout, though narrow over rostral plate. Top of head finely specked with brownish. Commisures of about 111th and 112th gastrosteges dusky all across. Upper labials creamy-brown like lower. Iris grayish. Length 15 inches. Morris County. Dr. J. C. Fisher.

This harmless little snake feeds on other small reptiles, amphibians, insects, etc., and is frequently to be found coiled up under stones or logs in woodland, and is sometimes met with in forest paths. It makes no demonstrations of defence when found, easily suffering capture.

Coluber punctatus Holbrook, N. Am. Herp., II, 1838, p. 115, Pl. 26.—Holbrook, l. c., Ed. 2, III, 1842, p. 81, Pl. 18.

Diadophis punctatus Abbott, Geol. N. J., 1868, p. 801.—Abbott, Nat. Rambles, 1885, p. 476.—Ditmars, Proc. Linn. Soc. N. Y., 1895-96, No. 8, p. 13.—Stone, Am. Nat., XL, 1906, p. 166.

Genus BASCANION Baird and Girard.

The Black Snakes.

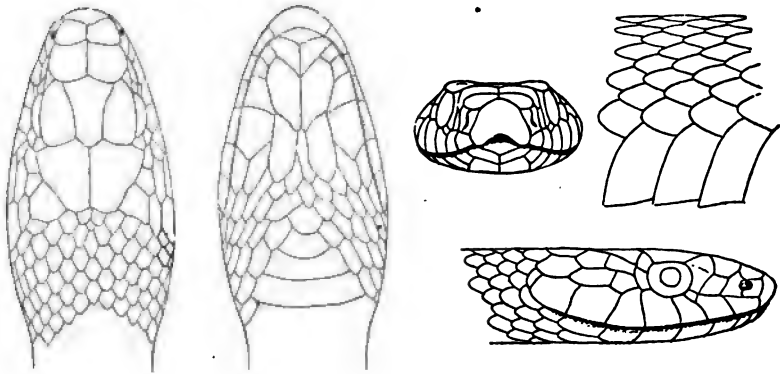
Bascanion constrictor (Linnæus).

PLATE 41.

Black Snake. Blue Racer. Racer. White Throated Racer.

Head slightly depressed, little distinct from body or but slightly swollen. Snout rather convexly depressed, its length about $1\frac{1}{3}$ in its width, and sides rather abruptly vertical. When viewed above profile obtusely convex, and convergence gradual, due to elongated ovoid head. Snout projects a little beyond mandible. Eye moderate, rounded, placed about midway in length of mouth

or over commissure of third and fourth superior labials. Frontal plate elongate pentagonally, anterior margin obtusely convex, sides concave, and convergence rather narrow to rather obtuse posterior angle. Its length a little less than that of parietals. Internasals broad, about half size of prefrontals, which are bent down over each side of snout to loreal. Parietals large, a little longer than broad, convergence posteriorly broad, and with broad median emargination. Rostral rather high, broad, and somewhat wedged between internasals. Nostril pierces commissure between nasals and internasal, at junction of all 3, and rather large. Loreal



Black Snake. *Bascamion constrictor* (Linnæus).

rather small, oblique, and trapezoidal. Supraocular elongately triangular, large. Preoculars 3, uppermost largest, and lowest very small. Postoculars small. Upper labials 7, fourth in contact with lower postocular and deepest, and sixth and seventh otherwise largest. Inferior labials 8, fifth largest. Temporals in 2 series between parietal and posterior labials. Scales smooth, enlarging on sides, thin, posterior angle moderately truncated to form somewhat hexagonal appearance. Exposed surface of outer row nearly as long as high. Transverse series of scales over back 16, and 248 counted from parietal plate down middle of back to tip of tail. Gastrosteges 182 to vent. Urosteges double. Tail about $5\frac{2}{3}$ in length of body, and narrowly tapering to pointed tip. Color in alcohol black above, with waxen appearance and below deep slaty, similarly waxen. Mandible, including also

first 5 inferior labials, some spots along inferior portion of upper labials, most of rostral below, and some spots on first few gastrosteges, pale creamy-brown. Iris dull slaty. Length 55 inches. Near Blairstown in Warren County. October, 1895. S. N. Rhoads. Also another example, smaller, with same data.

Of frequent occurrence, to the great disturbance of nesting birds. Easily distinguished from any of our snakes by its shining black color as it lies about bushes more or less concealed, or darts actively through the grass for the deceit of most imaginations that it is very much longer than in reality. It is said to attack man, and though sometimes it will bite, like the water snake this is little more than a scratch. It will, however, retreat should the pursued turn back. It may be easily tamed, and will submit to captivity. It feeds largely on small mammals, such as mice, shrews, etc. The constricting power according to Cope is also not serious, except possibly to a child. Others claim that it is in no sense a constrictor, taking its prey differently. Dr. Abbott says it was formerly abundant about Trenton at times, but has disappeared before the destructive mowing-machines. By most persons it is not regarded as venomous. About Dennisville, in Cape May County, this snake is said to occur. Some persons claim they know 2 varieties, both of which seem to be this species. The most common form is said to have a white throat, is slender and will assume the defensive, while the other is said to be more chunky and entirely harmless. It was reported to occur about Stone Harbor and Wildwood, Cape May County, several years ago, though few, if any, seem to have been seen lately. All these accounts may in part be uncertain, as the pilot snake also occurs near there.

Coluber constrictor Harlan, Journ. Acad. Nat. Sci. Phila., VI, pt. 2, 1827, p. 348.—Harlan, Med. Phys. Res., 1835, p. 112.—Holbrook, N. Am. Herp., IV, 1840, p. 75, Pl. 13 (ref. infers).—Holbrook, l. c., Ed. 2, III, 1842, p. 55, Pl. 11.

Bascanion constrictor Abbott, Geol. N. J., 1868, p. 802.—Lockwood, Am. Nat., IX, 1875, p. 5.—Abbott, Nat. Rambles, 1885, p. 476.—Ditmars, Proc. Linn. Soc. N. Y., 1895-96, No. 8, p. 15.—Stone, Am. Nat., XL, 1906, p. 166.

Genus *PITUOPHIS* Holbrook.

The Pine Snakes.

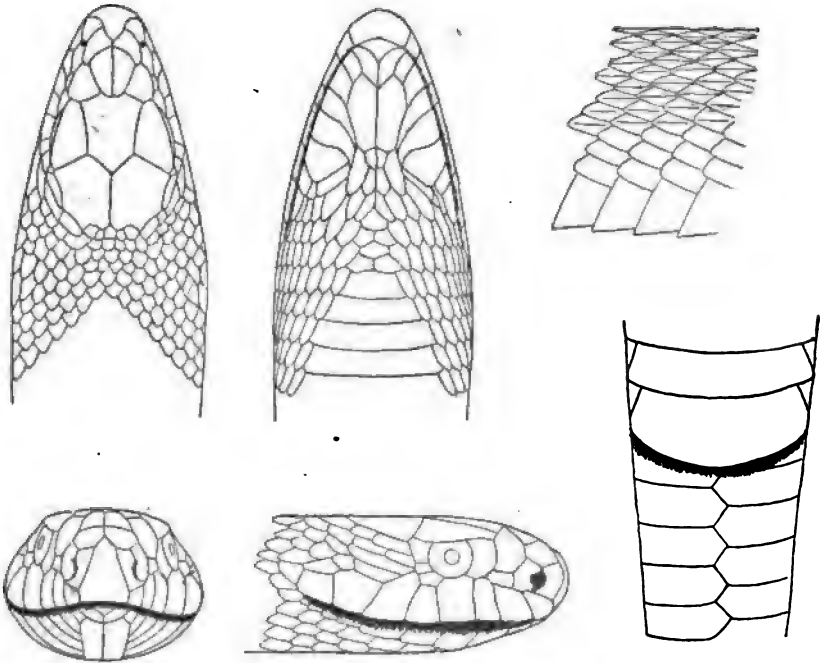
Pituophis melanoleucus (Daudin).

PLATE 42.

Pine Snake. Bull Snake. Carpet Snake. *Horned Snake.

Head small, scarcely distinct from body, ovoid and robust behind. In form obtusely conical, surface all strongly convex. Snout rather broadly convex, slightly depressed medianly above, its length about $1\frac{1}{4}$ in its width, and sides sloping down somewhat abruptly. When viewed above rather narrowly convergent, ending in a rounded tip. Snout blunt in profile, and well protruded beyond mandible. Eye moderately small, a little high, and placed about midway in length of head, or over commisure of fifth upper labial and lowest postocular. Frontal plate subpentagonal, rather broad anteriorly with an emargination for inner prefrontals, and posteriorly converging to well-marked angle. Inner prefrontals elongated and subtriangular, or convergent posteriorly. Internasals broad, rather large, and sloping convexly over edges of snout above down to nasals. Prefrontals rather small, elongate, sloping convexly over side of snout down to loreal, and expanded below. Parietals large, their length about $\frac{2}{3}$ of width, convergent posteriorly with a slight median notch, and each with an accessory posterior small plate approximated. Rostral elevated above surface of snout, narrow, surface very convex, and reaching most of length of median internasal commisure. Nostril large, in commisure of nasal plates, about midway in height of snout. Nasal plates large, anterior larger. Loreal small, ovoid and horizontal. Supraocular long, superior. Preocular large, and postoculars 3. Upper labials 8, sixth largest. Inferior labials 13, fifth largest. Temporals small, graduated to lowest, which is largest, and 4 in first row. Scales of back more or less keeled medianly, though becoming more obsolete till smooth along sides, in 24 series across back and 270 counted from

parietal shields to end of tail. Gastrosteges 203 to vent. Tail about $7\frac{6}{7}$ in body, robust, tapering rapidly to horny tip. Color in alcohol light yellowish-brown above, base of each scale dusky so that outline of each is emphasized in pale color. About 34 dusky-brown or blackish saddles over back, at first obsolete and scarcely defined till about after first half in length of body after which they are very sharply defined against pale color of upper surface. This anterior more or less dusky uniform ground-color



Pine Snake. *Pituophis melanoleucus* (Daudin).

due to fact that each blotch is marked with a splash of brownish on each side on posterior saddles, but progressing anteriorly they become more or less yellowish-brown, and pale interspaces are but slightly larger. Sides also in this region more or less speckled with yellowish-brown. Below in same region on sides, and alternating with blotches of back, are smaller and similar-color blotches which disappear posteriorly. Below and also alternating are a series of jet-black blotches on each lateral portion of 1 to

3 gastrosteges, and alternating with as many as 6 and as few as 4 of latter. On side of tail they disappear or are merged in saddles. Head dusky-brown above speckled with creamy-brown, which is color of all of under surface. Entire lower surface of body creamy-brown. Iris slaty. Length 55 inches. Speedwell in Burlington County. June 20th, 1901. Witmer Stone and J. A. G. Rehn.

This snake is met with in the wild pine-woods of the southern part of the State. Dr. Abbott says he has not found it about Trenton. Mr. J. A. G. Rehn found it fairly abundant about Staffords Forge, Ocean County. It was reported as rather scarce about Dennisville, in Cape May County, at times. It has been taken at Pitman Grove. The above-described example is about the usual adult size.

Coluber melanoleucus Harlan, Journ. Acad. Nat. Sci. Phila., V, pt. 2, 1827, p. 359.—Harlan, Med. Phys. Res., 1835, p. 122.

Pituophis melanoleucus Holbrook, N. Am. Herp., IV, 1840, p. 71, Pl. 12.—Holbrook, l. c., Ed. 2, IV, 1842, p. 7, Pl. 1.—Lockwood, Am. Nat., IX, 1875, pp. 1, 424.—Lockwood, l. c., XIV, 1880, p. 528.—Stone, Am. Nat., XL, 1906, p. 166.

Pityophis melanoleucus J. P. Moore, Am. Nat., XXVII, 1893, p. 878 (eggs).—Cope, Rep. U. S. Nat. Mus., 1898 (1900), p. 867.

Lampropeltis getula Abbott, Geol. N. J., 1868, p. 802 (evidently confused under king snake as it is also called "pine snake").

Genus THAMNOPHIS Fitzinger.

The Garter Snakes.

Key to the species.

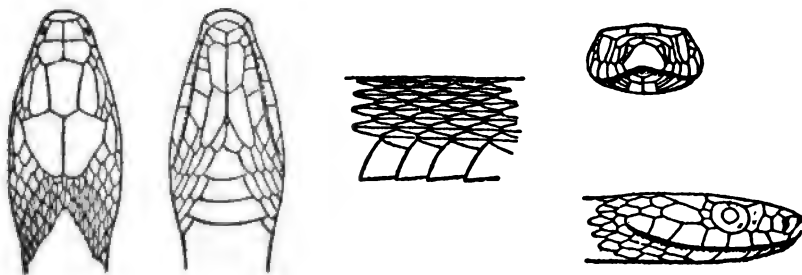
- a. Body slender; lateral stripe on third and fourth rows of scales. SAURITUS
- aa. Body robust.
 - b. Lateral stripe on second and third rows of scales. SIRTALIS
 - bb. No stripes, 2 rows of square spots on each side. SIRTALIS ORDINATUS

Thamnophis sauritus (Linnæus).

PLATE 43.

Riband Snake. Ribbon Snake. Garter Snake. Slender Garter Snake. Snake.

Head little distinct from body, sides but little swollen posteriorly, rather robust, and more or less depressed above, lower surface apparently more slightly convex. Snout rather pyramidal, depressed or flattened above, its length about $\frac{4}{5}$ its width as viewed above, and sides rather abruptly vertical. When viewed above elongately ovoid, with convergence rather abruptly ending in somewhat blunt or obtusely convex anterior profile.



Riband Snake. *Thamnophis sauritus* (Linnæus).

Snout projects well beyond mandible. Eye moderate, impinging on upper profile, and placed about midway in length of mouth or over commissure of fourth and fifth labials. Frontal plate elongately pentagonal, anterior margin obtusely convex, sides concave, and converging rather broadly to angle posteriorly. Internasals broad, rather obtuse, and little smaller than prefrontals, which bend down over side of snout to loreal. Parietals largest, elongate and converging back to an angle, with sulcus medianly posteriorly. Rostral large, convex. Nostril piercing commissure of nasals above at its junction with internasal. Loreal small, trapezoidal. Supraocular large, surface distinctly convex, and but slightly shorter than frontal. Preocular single, and 3 small subequal postoculars. Upper labials 8, sixth largest.

Lower labials 9, fifth largest. A single large temporal. Scales on back strongly keeled, dorsal in 19 transverse rows, and 276 counted down middle of back from parietal plates to tip of tail. Gastrosteges 149 to vent. Urosteges double. Tail about 3 in length of body, which is elongately slender, and tapering gradually in a long slender tip. Color in alcohol deep chocolate-brown on upper surface of body, and longitudinally with 3 well-defined creamy lines or narrow bands down back. Median beginning in parietal angle becomes obsolete on tail posteriorly. Lateral becomes slaty on tail and also fades out posteriorly. Below it along side also an annectant chocolate-brown narrow area like general color of back, though fading out below. Under surface of head, including all of labials, and body, varying pale or dilute greenish to brown. This color extends all way to tip of tail. Iris pale slaty. Length 31 inches. Swartzwood Lake, Warren County. October, 1905. Samuel N. Rhoads.

Color in life of an adult generally beautiful warm brown above with 3 longitudinal streaks of buff down back. Pale lateral streaks bounded below with a line of brown, though not so dark as back, and interspersed with small dusky spots. Below this dark lateral streak a pale terra-cotta tint extending its whole length, and inclining to creamy-white of lower surface. Side of head pinkish. Iris rich warm brown. A very striking short whitish preocular plate. Top of head plain brown, a little paler than back, and median buff streak beginning suddenly at occiput. Brown of head becoming pale on snout. Lower surface of head creamy-white. Line of demarcation of colors of head abrupt, owing to brown becoming dusky towards middle of side. Taken in a small fresh rain-pool at the eldge of the salt marsh, Palermo, Cape May County. April 15th, 1906. G. Z. Hartman, T. D. Keim and H. W. Fowler.

Found frequently about streams, but apparently much less abundant than its close relative, the garter snake. It is more slender than the garter snake and with the lateral stripe on the third and fourth rows of scales, while in the latter it is on the second and third. It is very gentle and is more aquatic than the garter snake, easily swimming about small streams. It is largely insectivorous. Examples are said to attain 3 feet in length, though

most I have seen were smaller. Dr. Abbott found it at Trenton in about equal numbers in comparison with *Thamnophis sirtalis*, a species which it also resembles in habits. Its food he found consisted largely of grasshoppers, crickets, etc.

Coluber saurita Harlan, Journ. Acad. Nat. Sci. Phila., V, pt. 2, 1827, p. 352.—Harlan, Med. Phys. Res., 1835, p. 115 (copied).—Holbrook, N. Am. Herp., IV, 1840, p. 87, Pl. 16 (ref. infers).

Leptophis sauritus Holbrook, l. c., Ed. 2, IV, 1842, p. 21.

Eutania saurita Abbott, Nat. Rambles, 1885, p. 476.

Thamnophis saurita Ditmars, Proc. Linn. Soc. N. Y., 1895-96, No. 8, p. 18.

Thamnophis sauritus Stone, Am. Nat., XL, 1906, p. 164.

Tropidonotus leberis Abbott, Geol. N. J., 1868, p. 802.

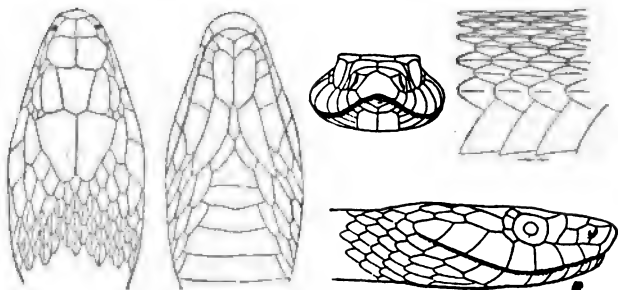
***Thamnophis sirtalis* (Linnæus).**

PLATE 44.

Garter Snake. Snake. Common Snake. Striped Snake.

Head somewhat distinct from body, sides a little swollen posteriorly, and upper and lower surfaces more or less depressed. Snout rather obtusely convex, sides of head broadly converging anteriorly so that when viewed above it is ovoid. Snout more or less flattened above, its length about $\frac{2}{3}$ its width, and its sides rather steeply vertical. It projects but a little beyond mandible. Eye moderately large, barely touching upper profile, and placed about midway in gape of mouth over commissure of fourth and fifth upper labials. Frontal plate a little elongated in a pentagon, anterior margin slightly convex, posteriorly broadly angular, sides slightly concave, and entire area but little longer than broad. Internasals rather broad, obtuse, and rather small. Pre-frontals much larger than internasals, bending down over side of snout to loreal, and broad. Parietals largest of plates, broad in front, and narrowly constricted posteriorly where there is a slight notch medianly. Rostral moderate, triangular in shape. Nostril rather large, placed in commissure between 2 nasals, just below that of internasal above. Loreal rather small. Supraocular

large, surface but slightly convex, equal to frontal in length and converging antero-laterally to preocular, which is single and rather large. Postoculars 3, subequal. Upper labials 8, sixth largest. Lower labials 9, sixth largest. A single large temporal meets median and upper end of lower postoculars. Scales on back strongly keeled, in 19 transverse rows over back, and 212 counted from parietal plates to tip of tail. Gastrosteges 144 to vent. Urosteges double. Tail about $4\frac{1}{2}$ in length of body, which is comparatively robust. Tail tapers gradually to a slender horny tip. Color in alcohol dull olive-brown, with grayish cast over back and upper surface generally. Down middle of back and along each side of body, bounding pale color of lower surface, 3 narrow pale plumbeous-green streaks or lines,



Garter Snake. *Thamnophis sirtalis* (Linnaeus).

median most distinct and best defined. Pale lateral streak extends along second and third series of scales above gastrosteges. Dark area of back spotted with warmer brown. Along first row of scales above gastrosteges a number of deep brown small spots placed more or less alternately about every 2 scales. Below these at lateral part of each of gastrosteges a small deep brown spot more or less concealed by overlapping of gastrostege following. Sides with pale bluish-green tinge, and entire lower surface pale brownish-green. Mandible creamy, and upper labials pale. Length 18 inches. Morris County. Dr. J. C. Fisher.

Also 2 others with same data, one larger than that described above and more brightly colored. It has the upper surface of the body decidedly bluish in alcohol, the spots all more or less blackish

and very conspicuous. Other examples from Trenton (Dr. C. C. Abbott), and Vincentown (Col. T. W. Bryan). The latter are very young, and are represented by many specimens. I have observed this species at Delanco, Burlington, Trenton, Newark, Ridgewood, Paterson, Medford and Cape May.

Color in life beautiful shining blackish on back, and upper surface generally, with a double series of alternate jet-black round spots down each side separated by a dilute dark greenish median line. On each side of body below these double series of dark spots, also a dilute greenish line from neck to vent, and then obscurely along side of tail where very narrow. This also marked in its course with small jet-black dots. Just below this a grayish-olivaceous dilute streak spotted finely with blackish, spots best defined on side of neck, and afterwards smaller and more numerous. Just below this on edge of each of gastrosteges a jet-black spot more or less concealed by overlapping, and producing a hemisphere. On same portion of trunk another irregular series of smaller ones. Lower surface of body otherwise clear hyaline-greenish. Lower surface of head creamy. Head dusky-brown above, upper edge of each labial blackish. Iris brownish. Length $10\frac{5}{8}$ inches. Found in fresh swamp along edge of salt marsh near Cold Spring, Cape May County, October 7th, 1906.

The first warm days of spring are associated with this snake, the small boy and the tin can. It is very variable, besides being our most abundant snake, and may be looked for in most any place. If disturbed it will assume the defensive, but usually soon becomes quiet if captured. The young are about 6 inches in length when born, and are said to number as many as 80. They are produced in the late summer and early fall. I have seen a bundle of the adult snakes early in the spring, on a warm day, which must have numbered nearly 50, and sometimes smaller bundles of a dozen. This habit may be attributed, perhaps, to hibernation, or possibly several impulses. The garter snake attains a size about equal to that of the ribband snake, but is more robust.

Coluber sirtalis Holbrook, N. Am. Herp., IV, 1840, p. 91, Pl. 16 (ref. iners).

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Tropidonotus sirtalis Holbrook, l. c., Ed. 2, IV, 1842, p. 41, Pl. 11.

Tropidonotus dirtalis Abbott, Geol. N. J., 1868, p. 802 (lapsus for *T. sirtalis*).

Eutania sirtalis Abbott, Nat. Rambles, 1885, p. 476.

Thamnophis sirtalis Ditmars, Proc. Linn. Soc. N. Y., 1895-96, No. 8, p. 19.—Stone, Am. Nat., XL, 1906, p. 164.

***Thamnophis sirtalis ordinatus* (Linnæus).**

Spotted Garter Snake.

Said to differ from the above in the absence of stripes and in having 2 rows of square spots on each side.

It is closely related to the above, apparently differing only in coloration. I have not seen any New Jersey examples.

Thamnophis sirtalis ordinata Ditmars, l. c., p. 20.

Genus LAMPROPELTIS Fitzinger.

The Chain Snakes.

Key to the species.

- | | |
|----------------------------------------------|---------------------|
| a. Color chiefly black. | GETULUS |
| aa. Color grayish or reddish. | |
| b. Alternate spots entirely on scales. | DOLIATUS TRIANGULUS |
| bb. Alternate spots largely on gastrosteges. | DOLIATUS CLERICUS |

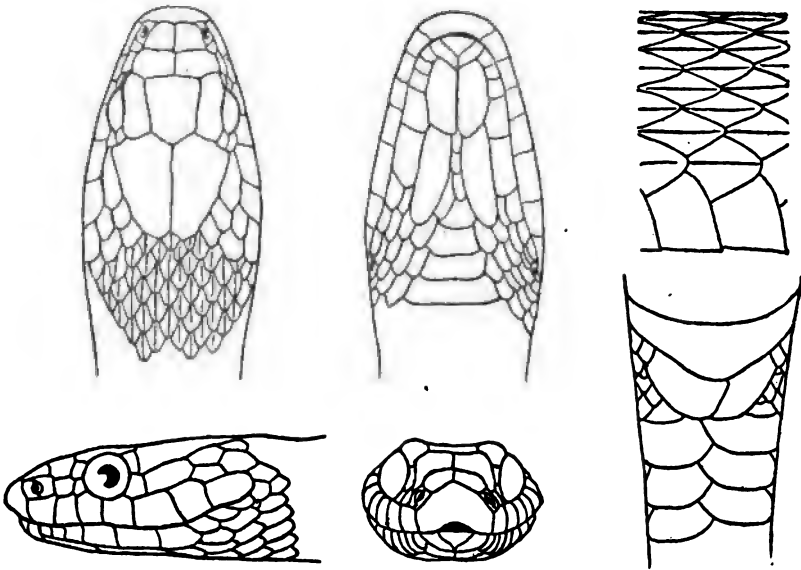
***Lampropeltis getulus* (Linnæus).**

PLATE 45.

Chain Snake. Thunder and Lightning Snake. Thunder Snake.
Wamper. King Snake. Wampum Snake.

Body robust, tapering rather more anteriorly than towards end of tail. Head conic, little distinct, scarcely depressed, except anteriorly, and when viewed above rather narrowly elongate so

that general outline would be elongate-ovoid. Snout depressed, surface convex, its length about $\frac{2}{3}$ its width, and as viewed above rather obtusely convex in front. Eye small, midway in length of mouth and over commissure of third and fourth upper labials. Mouth a little undulate, and gape posteriorly superior. Upper labials 8, mostly higher than long, and fifth largest. Lower labials 10, and fifth largest. • Rostral broadly lunate, slightly impinging on anterior emargination of internasals. Postoculars 2, small, nearly equal, and preocular single. Loreal small.



Chain Snake. *Lampropeltis getulus* (Linnæus).

Supraocular moderate, narrowly convergent anteriorly. Nasals 2, nostril piercing anterior just before commissure. Internasals rather broad. Prefrontals also broad, and nearly twice as large. Frontal subpentagonal, rather narrowly convergent behind, and broad in front with scarcely an angle. Parietals broad, convergent posteriorly, and with a median posterior notch. Pre-genials shorter than postgenials. Scales smooth, 21 transversely over back and 256 counted from parietal plates to tip of tail. Gastrosteges 105 to vent. Urosteges divided, 41 in number.

Tail conic, rather robust, not especially tapering, and its length $7\frac{1}{2}$ in rest of body. Color in alcohol deep dusky-brown, lower surface scarcely if any paler. About 40 creamy-white transverse narrow bands or lines over back which bifurcate on flanks, bifurcations joining a similar colored spot at gastrosteges. These lines divide back into a series of large dark hexagons, each line being about half length of a scale in width. Each pale or whitish lateral blotch sends off similar colored bar on each lateral portion of 1 or more gastrosteges. Lower surface of body more or less speckled with whitish. Head also whitish below, with edges of scales dark. Some few spots and bars above of same color. Eye creamy. Length 39 inches. New Jersey. P. Doyle and B. Badger.

Dr. Abbott says it is rare and timid about Trenton. Mr. D. McCadden obtained it at Cape May. I have examined examples from Bridgeton, Beesley's Point (Samuel Ashmead), and Point Pleasant (A. P. Brown and Witmer Stone). This snake though harmless will attack and devour other snakes, even when larger than itself. On one occasion an example of this species and a much larger example of *Pituophis* were confined in a small box by Mr. McCadden, and when examined a short time after the smaller king snake had succeeded in swallowing a good portion of his larger companion. It is said that it will even devour the venomous rattlesnake, which seems to have earned it the name of king snake. It also takes other food such as salamanders, lizards, frogs, toads, small birds, mammals, etc. It is said to occur usually in moist shady places and never climbs trees or enters the water.

Coluber getulus Holbrook, N. Am. Herp., IV, 1840, p. 63, Pl. 10 (ref. infers).

Coronella getula Holbrook, l. c., Ed. 2, III, 1842, p. 95, Pl. 21.

Lampropeltis getula Cope, Proc. Acad. Nat. Sci. Phila., 1860, p. 255.—Abbott, Geol. N. J., 1868, p. 802.—Stone, Am. Nat., XL, 1906, p. 167.

• *Lampropeltis dolliatus triangulus* (Boie).

Differs from the next in having alternate spots entirely on the scales.

I have no New Jersey examples, and include this form on the references to authors.

Lampropeltis triangula Cope, Proc. Acad. Nat. Sci. Phila., 1860, p. 256.—Abbott, Geol. N. J., 1868, p. 802.

Lampropeltis doliatus triangulus Ditmars, Proc. Linn. Soc. N. Y., 1895-96, No. 8, p. 13.

Lampropeltis doliatus clericus (Baird and Girard).

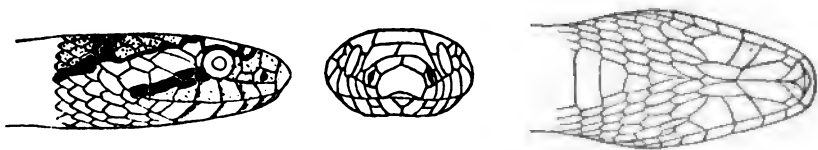
[PLATE 46. *Lampropeltis doliatus* (Linnaeus).]

House Snake. Milk Snake. Spotted Adder.

Body rather robust, cylindrical, and tapering more or less from middle towards each end. Head little distinct from neck, rather flat, and as viewed above rather narrowly and obtusely ovoid. Snout broad, surface convex, its length about $1\frac{3}{7}$ in its width, and as viewed above rather obtusely convex in outline, with broad convergence. Eye small, a trifle anterior in length of mouth, and placed over commissure of third and fourth upper labials. Mouth a trifle undulate in profile, and posteriorly only very slightly oblique. Frontal plate broadly subpentagonal, scarcely angled on front edge, posteriorly broadly angled with sides of convergence slightly and scarcely concave. Internasals small, broad and about half size of prefrontals. Prefrontals large, broad, and bent over a little on side to loreal. Parietals very large, broad, widely convergent posteriorly and with a slight median posterior notch. Supraoculars rather small, convergent slightly in front. Postoculars 2, upper larger. One preocular, rather deep. Loreal small, elongate. Nasals 2, anterior larger and nostril piercing it just before internasal commissure. Rostral large, and broadly lunate. Upper labials 7, and sixth largest. Lower labials 9, and fifth largest. • Pregenials longer than postgenials. Temporals in 2 series, first of 2 elongate narrow plates and second of 3 quadrate ones. Scales on back all smooth, in about 21 transverse series, and 265 counted from parietals to tip of tail. Gastrosteges 194 to vent. Urosteges double, about 50

in number. Tail cylindrical, tapering to a pointed tip, and about 6 in entire length of body. Color in alcohol dull brownish-white over general ground-color, and about 47 broad saddles of pale tawny-brown with deep black edges or borders, over back. Alternating on sides small blotches similar in color to those on back at first, but progressively they become more clouded with blackish until last ones are more or less entirely black. They are largely on gastrosteges. After middle of body on outer portions of gastrosteges, for space alternating every 4, a series of jet-black gastrostegial blotches, one to each along each side of median line. They also continue on urosteges. Ground-color of under surface brownish-white. Iris slaty. Length 36 inches. Moorestown. Dr. A. E. Brown.

Color in life deep brown on back or over extent of about 60 saddles which extend to vent, after which they become obsolete on upper surface. Each of these saddles slightly edged with

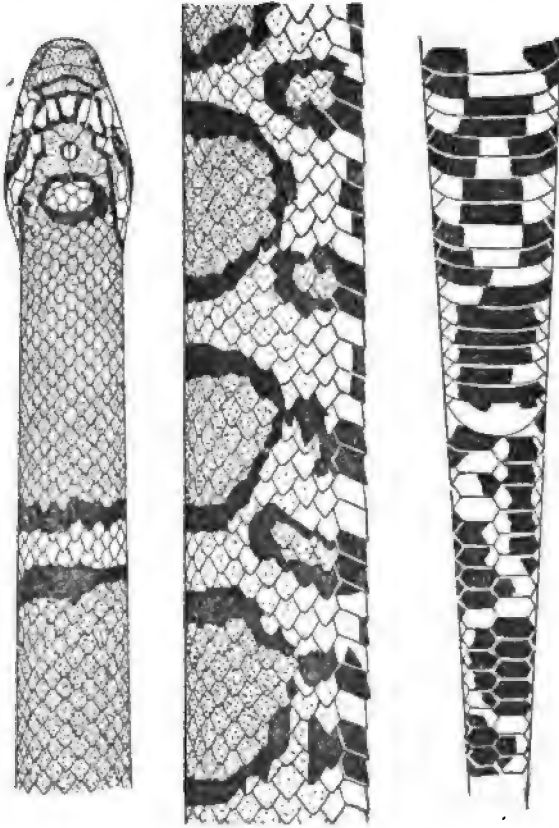


House Snake. *Lampropeltis doliiatus clericus* (Baird and Girard).

dusky though as a rule rather inconspicuous and intervening narrow areas together with sides grayish, becoming paler below. Along each side in gray areas about 3 or sometimes more, as they are irregular, series of warmer brownish spots than saddles. Some also extending on each edge or sides or gastrosteges of trunk. Lower surface of head wax-white, becoming more livid and brownish posteriorly so that lower surface of tail is largely uniform pale brownish. Head brownish above, sides deep grayish after eye, and labials whitish with deep brown spots. Oculars pale. Iris warm brown. Length 17 inches. This snake was taken from another, probably *Natrix*, which had seized it by the neck transversely, evidently for the purpose of swallowing. Cold Spring, Cape May County. October 7th, 1906.

Dr. Abbott says that it resembles *Lampropeltis getulus* in its timidity, though more domestic, in the vicinity of Trenton. He

relates that he saw one curl up and vibrate its tail among dead leaves and thus produce a somewhat good imitation of the rattlesnake. I have examined examples from Shower Hill in Camden County taken May 12th 1902 (S. N. Rhoads), at Haddonfield (Dr. G. Watson), and Trenton (Dr. C. C. Abbott), which all appear to be *clericus*. Mr. Witmer Stone is of the opinion



House Snake. *Lampropeltis doliaetus clericus* (Baird and Girard).

that all the New Jersey examples he has examined are *clericus*. It may be distinguished as a race from *triangulus* by having the dark lateral spots more on the gastrosteges. Possibly the latter may occur in the upland fauna. It is harmless, and a valuable agent in the destruction of small mammals, many of

which are injurious to the agriculturist. It has earned the name milk snake from its frequenting spring-houses, where the dairyman keeps his milk. Although it may take milk its occurrence in such situations is, perhaps, more largely due to the abundance of frogs and other animal life.

Coluber doliatus Harlan, Journ. Acad. Nat. Sci. Phila., V, pt. 2, 1827, p. 362.—Harlan, Med. Phys. Res., 1835, p. 125.

Lampropeltis doliata Abbott, Geol. N. J., 1868, p. 802.

Ophibolus doliatus Abbott, Nat. Rambles, 1885, p. 476.

Coluber eximius Holbrook, N. Am. Herp., IV, 1840, p. 81, Pl. 14 (ref. iners).

Carphophiops amæna Abbott, Geol. N. J., 1868, p. 801.

Genus HETERODON Latreille.

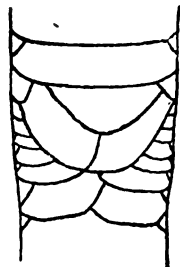
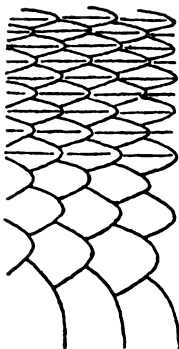
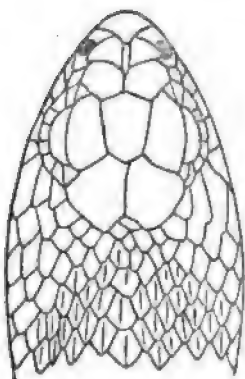
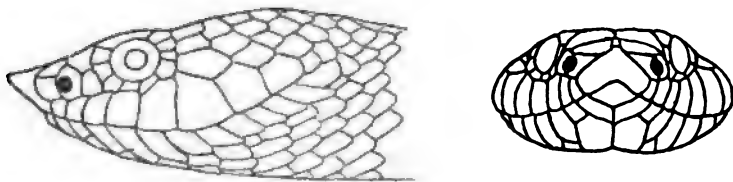
The Hog Nosed Snakes.

Heterodon platirhinos (Latreille).

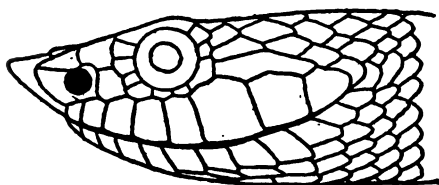
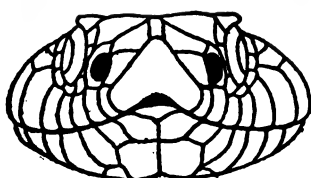
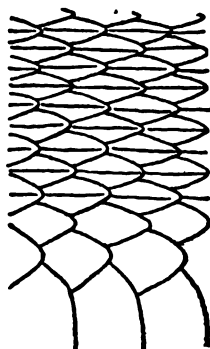
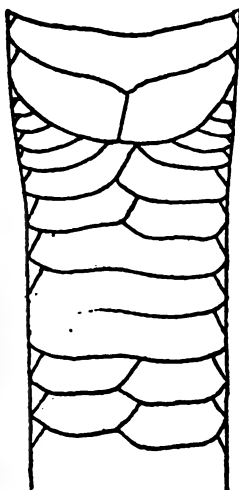
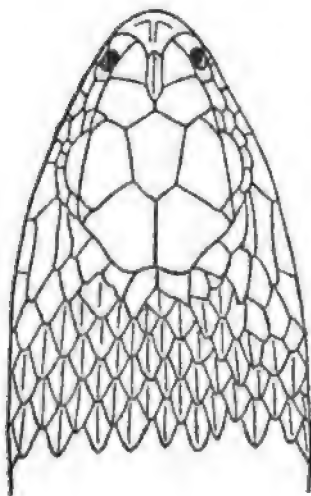
PLATE 47.

Hog Nosed Snake. Hog Nose Snake. Blower. Blowing Viper. Adder. Hissing Viper. Spotted Adder.

Head not distinct from body, depressed, and sides not swollen. When viewed above upper surface of head producing rather even triangular outline, lines of convergence to tip of snout nearly straight, where slightly rounded. Snout depressed, surface convex and its length about $\frac{3}{4}$ its width. It projects far beyond mandible, and its sides rather abruptly vertical posteriorly. Eye rather large, and a little anterior in space between tip of snout and last lower labial, or with fifth upper labial falling about mid-way in its own diameter. Frontal plate elongately pentagonal, rather broadly convex anteriorly, and converging posteriorly to right angle. Internasals rather small, entirely separated by, azygos or postrostral, and rostral posteriorly. Prefrontals rather large, broad, and with lateral angle extending down to loreal.



Hog Nosed Snake. *Heterodon platirhinos* (Latreille).



Hog Nosed Snake. *Heterodon platirhinos* (Latreille). (Black form.)

Parietals large, very broad, and convergence posteriorly convex with median slight posterior emargination. Rostral with outline as viewed above spherical, surface above with median keel, lower surface flattened, and produced posteriorly between internasals to join azygos, which in turn is wedged back midway between prefrontals. Apex of rostral acute, and as viewed in front its form nearly an equilateral triangle. Azygos plate linear. Nostril large and piercing large postnasal plate. Prenasal moderate. Loreal rather small. Superciliaries rather large. Supraocular wide as frontal, and not much narrowed anteriorly. Preoculars 3, infraoculars 2, postoculars 4, and all these of subequal size. Labials 8 above, sixth and seventh largest, and third to sixth in contact with suborbitals. Lower labials 11, first and fourth largest. Temporals 3 in first row, graduated down to lowest which is largest. Scales on back all more or less keeled, but progressively smoother down sides till just above gastrosteges, where they are entirely smooth on first row at least. In 25 series over back transversely, and 184 from parietal plates to tip of tail. Gastrosteges 131 to vent. Urosteges divided, or in a double series. Tail small, quadrangular towards base, and rapidly tapering to slender tip. Its length $6\frac{1}{3}$ in body. Color in alcohol light brown generally, and back medianly shaded darker brown, with about 38 transverse pale brown broad bars over back more or less regularly. These bars color of belly, and margined in front and behind with dusky, and at each end touching a blackish lateral blotch. At first lateral blotches very distinct, but gradually become paler, and are absent on side of tail. Head brownish above, its lower surface and entire lower surface of body immaculate brownish-white. Iris slaty. Length about 27 inches. Beesley's Point. Samuel Ashmead. Also 9 others with same data.

Color in life dull gray-brown generally, with about 35 dusky-olive blotches down middle of back to tip of tail. At first these largely blackish, then olive becomes more general, and restricted blackish forms margins to grayish-brown interspaces. These latter then form pale blotches which are due to alternate blackish blotches along side, which gradually block end of each pale

spot. Below these on each side a double series of short narrow irregular or broken blackish vertical wavy streaks. Gastrosteges all more or less dusky-edged, and more or less alternately at each side with large dark or blackish marks. On short tail uniform pale brownish-white, also no lateral marks. Lower surface of trunk grayish-white generally, and that of head creamy. A deep brown interocular bar, and another postocular. Labials finely peppered with brownish. Length $6\frac{3}{8}$ inches. On the railroad near Cold Spring, Cape May County. October 7th, 1906.

Both a brown and dark form were found on Dr. Abbott's meadows near Trenton, though the latter was the less abundant. Those of the dark form he saw were all adults, 2 feet or a little over, in length. This snake is frequently reported to be venomous though, of course, perfectly harmless. It will flatten and swell out till distended several inches in width when disturbed or alarmed. They prefer dry open fields and feed on grasshoppers, mice, moles, shrews, etc. Mr. Fox killed 1 about 1895 near Bridgeton. It is reported from about Dennisville, in Cape May County, and is said to be abundant. Mr. McCadden has observed it at Stone Harbor. I have examined a number of examples from Bridgeton, Point Pleasant (A. P. Brown and Witmer Stone), Cape May Point (J. B. Ives), and 1 without definite locality (Dr. J. E. Holbrook).

Heterodon platirhinos Holbrook, N. Am. Herp., II, 1838, p. 97, Pl. 21.—Holbrook, l. c., Ed. 2, IV, 1842, p. 67, Pl. 17.

Heterodon platyrhinus Abbott, Geol. N. J., 1868, p. 802.

Heterodon platyrhinos Lockwood, Am. Nat., IX, 1875, p. 10.—Stone, Am. Nat., XL, 1906, p. 167.

Heterodon platyrhinus Abbott, Am. Nat., XVI, 1882, p. 708.—Abbott, Nat. Rambles, 1885, p. 476.—Ditmars, Proc. Linn. Soc. N. Y., 1895-96, No. 8, p. 17.—Cope, Rep. U. S. Nat. Mus., 1898 (1900), p. 761.

Family CROTALIDÆ.

The Rattle Snakes.

Body stout. Head large, flat, triangular, and on a slender neck. Pupil elliptical, placed vertically. Maxillary vertical, without solid teeth, but provided with long erectile poison fangs, one on each side in front. A deep pit between eye and nostril extending into the excavated maxillary. Scales keeled in our species. Anal plate entire. Subcaudal plates generally undivided, at least anteriorly. Tail usually provided with a rattle composed of modified horny rings.

Viviparous serpents, attaining in some cases a large size, and renowned for their venom. All are American and comprise about a dozen genera.

Key to the genera.

a. Tail short, without rattle, ending in a horny point.

AGKISTRODON

aa. Tail with a rattle.

CROTALUS

Genus AGKISTRODON Beauvois.

The Copper Head Snakes.

Agkistrodon contortrix (Linnæus).

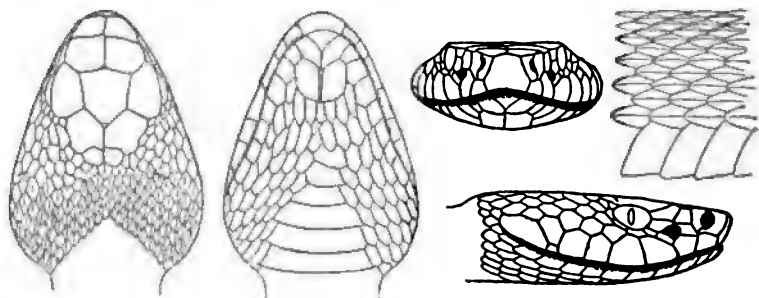
PLATE 48.

Copper Head Snake. Copper Head. Copper Belly. Copper Adder. Copper Viper. Copper Snake. Chunk Head. Deaf Adder. Rattle Snake's Mate.

Body robust, more or less ovoid in cross-section of trunk, with bulge a little below, and tapering but little or rather abruptly both anteriorly and posteriorly. Head small, well depressed, broad, and as viewed from above broadly ovoid or its greatest bulge about last $\frac{2}{3}$ of its length. Snout broad, obtuse, upper surface flat, its sides more or less steeply and slightly converging below,

and upper edge of profile as seen from above with tip of snout rather broadly rounded. Eye a little elongate, high, about first $\frac{3}{7}$ in length of mouth. Mouth with a long undulated gape, or slightly double-convex as seen laterally. Rostral plate truncate above, not extending on upper face of muzzle, lateral borders and its lower surface concave. Upper labials 9, and third, fourth, fifth, sixth and seventh subequally larger. Second upper labial bounding front margin of pit, twice as high as long, and reaching loreal and middle preocular above. Third upper labial trapezoidal. Lower labials 10, first largest, and last smallest, others subequal more or less. Upper prefrontal larger than middle preocular, which bounds posterior margin of pit. Lower preocular small, with another similar small scale directly in front over upper front margin of third supralabial and forming lower posterior boundary of pit. First infraocular largest of rest of series, including postoculars, all of which are subequally small. Supraocular large, extending both anterior and posterior to frontal, and its width about $1\frac{1}{3}$ in its length. Prefrontal in contact in front and much larger than internasal, which is rather elongate. Nasals rather large, and nostril piercing most of commissure. Frontal consisting of 5 elements, 4 of which are largely marginal. Parietal plates a little smaller than prefrontals. Loreal plate small, trapezoidal. Symphyseal plate nearly equilaterally triangular. Pregenials well developed, large, and postgenials in 3 or 4 series, narrow and much shorter. Rest of upper surface of head covered with small convex scales. Scales on back all strongly keeled, and lateral series in contact with gastrosteges, more or less smooth, though each with a slight median ridge or keel on posterior portion of body. Scales in 23 transverse series over back. About 200 scales counted from occipital plates to tip of tail. Gastrosteges about 127 to vent. Urosteges single, about $39+8+1$ in number to tip of tail. Tail short, robustly rounded, tapering to tip, and about $5\frac{1}{2}$ in body. Color in alcohol pale mauve generally over back and upper surface of body. Upper surface of head very pale or light yellowish-brown, uniform, and extending also down over sides and entire under surface of head. Entire surface of body when examined closely found to be finely and obscurely specked or dotted with minute points of same shade as ground

color, rarely much darker. Over back about 18 transverse deep or rich sienna hour-glass-shaped bands or blotches, expansions below on each side, where they become gradually paler, like general tint of back, so that their lower boundaries are not defined. Both anterior and posterior inner portions of dorsal blotches becoming deeper brown or burnt-umber marginally. Ground-color also becomes paler around edges of dorsal blotches, increasing their distinctness. A narrow deep brown streak back from eye till around posterior margin of both last upper and lower labial plates, and then forward about midway in depth of lower labials, stopping opposite pit. About 28 deep brown blotches along gastrosteges laterally, well separated, arranged regularly on both sides of body, each one extending about over 2 gastrostegal scales and over 1 series above, where they are



Copper Head Snake. *Agkistrodon contortrix* (Linnæus).

deepest in color, and their lower moieties fading out in general color of belly. Alternately between these lateral dark blotches pale brown ones, though only distinct on throat, and also placed further down or more inferiorly on gastrosteges. After these become entirely ventral, gastrosteges have an obscure pale mottled-brown appearance, general color being a paler though similar tint to that of back. Upper surface of tail with 3 dorsal blotches complete, lower surface immaculate, and distal half sulphur-yellow, both above and below. Iris pale coppery, pupil pale grayish. Length $9\frac{3}{4}$ inches. Round Lake in Kittahanny Mountains, Sussex County, July 6th, 1907. B. W. Griffiths.

I have only the above example of this dangerous animal. It is said to prefer damp places, and is rare in most localities.

Trigonocephalus contortrix Holbrook, N. Am. Herp, II, 1838, p. 69, Pl. 14 (ref. infers).—Holbrook, l. c., Ed. 2, III, 1842, p. 39, Pl. 8.

Agkistrodon contorting Abbott, Geol. N. J., 1868, p. 801 (lapsus for *A. contortrix*).

Agkistrodon contortrix Ditmars, Proc. Linn. Soc. N. Y., 1895-96, No. 8, p. 23.

Scytalus cupreus Rafinesque, Am. Journ. Sci. Art., I, 1819, p. 84.—Harlan, Med. Phys. Res., 1835, p. 130.

Genus CROTALUS Linnæus.

The Rattle Snakes.

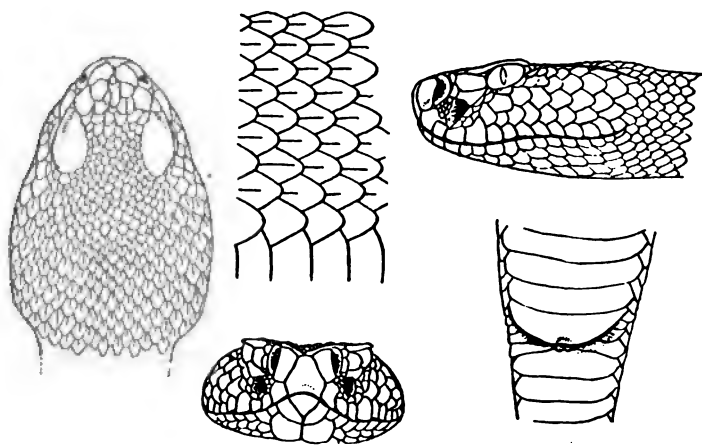
Crotalus horridus Linnæus.

PLATE 49.

Rattle Snake. Rattler.

Body robust, more or less ovoid in cross-section of trunk, with bulge below, and tapering but little or rather abruptly both anteriorly and posteriorly. Head rather small, broadly depressed, and as viewed from above its shape broadly convex or with greatest bulge about posterior third of its length. Snout obtuse, broad, upper surface flattened, sides more or less steep, and upper edge of profile as seen above convex, with but slight anterior constriction. Eye rather elongate, high, about first $\frac{3}{5}$ in length of mouth. Mouth with a long undulated gape, or double convex as seen laterally. Rostral plate subpentagonal, and but slightly impinging on anterior internasal margin medianly. Upper labials 14, first and fourth largest. Lower labials 15, and first largest. Scales in 3 series between eye and upper labials. Preoculars 2, upper larger, and lower forming posterior boundary to deep pit. Loreals 2, small, and lower a trifle larger. A very small scale between upper loreal and supraocular. Infraoculars 2, and postoculars 2. Supraocular nearly ellipsoid and large as seen from above. A small prefrontal in contact in front, not quite as large

as internasals, which are subtriangular with broad convergence anteriorly. Nasals rather deep, and nostril piercing most of posterior just after commissure. Rest of upper surface of head covered with small tuberculated scales. Scales on back all strongly keeled, and lateral series in contact with gastrosteges more or less smooth, though each with a slight median ridge or keel on posterior portion of body. Scales in 22 transverse series over back. About 220 scales counted from internasal plates to tip of tail, and rattles 9 in number. Gastrosteges 171 to vent. Urosteges single, 19 in number to rattle. Tail short, robustly rounded, slightly tapering to rattle, and about $11\frac{1}{3}$ in body. Color in alcohol light brownish below, upper surface darker or



Rattle Snake. *Crotalus horridus* Linnæus.

more or less tawny. On each side of median dorsal line 2 series of deep brownish dorsal blotches anteriorly, becoming confluent, and as broad or broader than paler interspaces. Blotches 24 in number, and upper median series larger on anterior part of body. Edges of these dark blotches all with more or less narrow traces of blackish within their areas, and paler brownish than ground-color without. Alternating between each of lateral dark blotches along each side of median line of gastrosteges, regular clusters of brownish dots over each group of 3 or 4. Under surface of tail deep brown like dark blotches on back and all of its

upper surface. Head all more or less pale brownish, whitish on lower sides and under surface. Iris pale slaty. Teeth pale. Length about 40 inches. Pemberton. Dr. Coleman.

Dr. Abbott says that he never saw an example near Trenton, though late in the eighteenth century it may have been killed in bogs turned out in the fall. About 30 years ago a stranded individual came down the Delaware on a raft. One was killed near Tuckerton recently, according to reports given to Mr. J. A. G. Rehn. Mr. H. Walker Hand reports that another was killed about 1900 in a swamp near Negocan, Cape May County, and also another about 1898 at the headwaters of the Maurice River.

Crotalus horridus Cope, Proc. Acad. Nat. Sci. Phila., 1859, p. 338.—Ditmars, Proc. Linn. Soc. N. Y., 1895-96, No. 8, p. 24.—Stone, Am. Nat., XL, 1906, p. 167.

Candisona horrida Abbott, Geol. N. J., 1868, p. 801.

Crotalus boiquire Beauvois, Trans. Am. Philos. Soc. Phila., IV, 1799, p. 370.

Crotalus durissus Harlan, Journ. Acad. Nat. Sci. Phila., VI, pt. 2, 1827, p. 368.—Harlan, Med. Phys. Res., 1835, p. 132.—Holbrook, N. Am. Herp., II, 1838, p. 81, Pl. 17 (ref. infers).—Holbrook, l. c., Ed. 2, III, 1842, p. 9, Pl. 1.—Bryan, Am. Nat., XIII, 1879, p. 322.

Order LACERTILIA.

The Lizards.

Limbs 4, distinct, rarely rudimental and hidden by the skin. Shoulder-girdle developed. Feet usually with 5 digits, phalanges normally 2, 3, 4, 5, 3, or 4. Tail usually long, often brittle, so that it breaks by a slight blow, and this due to a thin unossified transverse septum which traverses each vertebra. Quadrate bone articulated to the skull. Parts of ali- and orbito-sphenoid regions fibro-cartilaginous. Rami of mandible united by suture. Temporal region without or with only 1 horizontal bar. Mouth not dilatable. Tongue free. Jaws always with teeth. Body not shielded, usually covered with overlapping scales. Vent a transverse slit. Copulatory organs present, paired.

The great majority of the numerous species inhabit the tropics or sub-tropical regions, and the few found within our limits give but a slight idea of this whole great group.

Key to the families.

- a. Tongue covered with imbricate scale-like papillæ or with oblique plicæ;
clavicle dilated proximally, often loop-shaped. SCINCIDÆ
- aa. Tongue smooth or with villous papillæ; clavicle not dilated proximally. IGUANIDÆ

Family SCINCIDÆ.

The Skinks.

Body fusiform or cylindrical. Tongue moderately long, free and feebly nicked in front, and covered with imbricate scale-like papillæ. Dentition pleurodont, teeth conical, bicuspid, or with spheroidal or compressed crowns. New teeth hollow out bases of old ones. Pterygoid teeth present or absent. Pupil round. Eyelids well developed. Premaxillaries 2, sometimes incompletely separated. Nasal double. Frontal single or double. Parietal single. Postorbital and postfrontotemporal arches complete, osseous. Interorbital septum and columella-cranii well developed. Infraorbital fossa present, bounded by maxillary, transverse bone, palatine and also often by pterygoid. Limbs present in our genera. Pectoral and pelvic arches constantly present. Clavicle dilated and usually perforated proximally, interclavicle cruciform. Ossified abdominal ribs absent. Toes compressed, 5-5. Body protected by bony plates underlying scales which are cycloid-hexagonal, rarely rhomboidal, imbricate, arranged quincuncially. These plates provided with symmetrical tubules.

A large family with many genera and species in most parts of the world.

Key to the genera.

- a. Palatine teeth present; 2 supranasal plates; lower eye-lid scaly. EUMECES
- aa. Palatine toothless; no supranasal plates; lower eye-lid with a transparent disk. LEIOLOPISMA

Genus *EUMECES* Wiegmann.

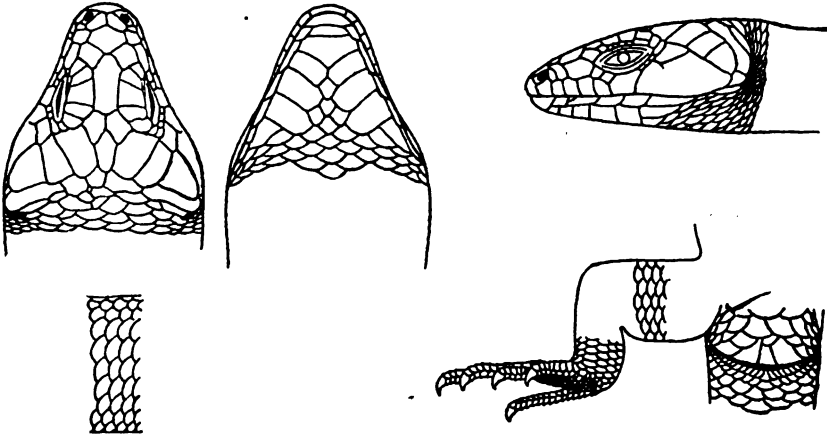
The Blue Tailed Skinks.

Eumeces fasciatus (Linnæus).

PLATE 50.

Blue Tailed Lizard. Blue Tailed Skink. Skink. Blue Tail.
Scorpion. Five Lined Lizard.

Color blackish-olive with 5 longitudinal streaks, middle 1
forked on head, and tail usually bright blue. Old examples



Blue Tailed Lizard. *Eumeces fasciatus** (Linnæus).

with stripes wanting or obsolete, more or less reddish-olive, and head becoming coppery-red with age. A variable species reaching a length of 11 inches.

I have not seen any New Jersey examples, and only know of its occurrence by reports. Messrs. Witmer Stone and J. A. G. Rehn say that persons residing near Jones' Mill claim to find it in the cedar-slab piles. It is probably not so rare as one would suppose, though on account of being unfrequently seen by naturalists may be thought so. It is very swift in its movements and runs rapidly over the ground, and like the pine tree

lizard its tail breaks off very readily. Dr. Abbott tells me he secured an example at Lake Hopatcong. When kept in captivity it did not become tame, was savage, and would always snap if disturbed. This example was of a nearly uniform mahogany-color, and about 8 inches long. He found that it would feed largely on the house-fly. About Dennisville, in Cape May County, this little lizard was reported to be abundant at times during the summer months. It would frequently be seen running over piles of old bark about the old saw-mills, and was said to be very active. Sometimes they would run over the screens of houses. Most all had bright blue tails. In this region, or south, Dr. J. P. Moore says he has met with it.

Eumeces fasciatus Abbott, Pop. Sci. Month., XXXIV, 1889, p. 170, fig. —J. Nelson, Geol. Surv. N. J.; II, Zool., 1890, p. 642.—E. Smith, Proc. Linn. Soc. N. Y., 1898-99, No. 11, p. 18.—Stone, Am. Nat., XL, 1906, p. 168.

Scincus quinquelineatus Harlan, Journ. Acad. Nat. Sci. Phila., VI, pt. 1, 1829, p. 10 (ref. infers).—Harlan, Med. Phys. Res., 1835, p. 138.

Plistodon striatus Abbott, Geol. N. J., 1868, p. 801.

Genus *LEIOLOPISMA* Duméril and Bibron.

The Black Banded Lizards.

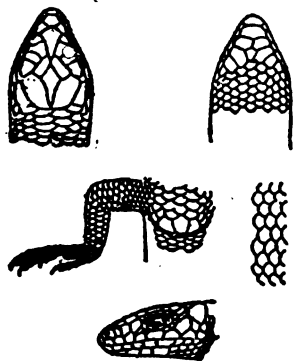
Lelolopisma laterale (Say).

PLATE 51.

Black Banded Lizard.

Body long and slender, somewhat quadrangular. Head and trunk $1\frac{2}{3}$ in tail. Head rather depressed. Snout depressed, tip bluntly rounded, and mandible similar. Eye lateral, elongate, and about midway in length of head. Lower eyelid with a transparent disk. Eyelids movable. Teeth minute. Interorbital space equal to gape of mouth. Ears smaller than eye, vertical. Tongue flattened and rather large. Scales very thin, membranous, about 30 rows around body. Frontal plate in contact in front with

rostral, and behind with vertical. Prefrontal plates small, lateral. Nostril pierced in nasal plate, above first labial, in contact above with internasal. Postnasal plate and 1 loreal in contact with postfrontal. Upper labials 7. No scales on lower eyelids. Vent rounded. Legs well developed, posterior larger and best developed. When hind legs are applied twice forward they reach half way between arm and ear, or contained 3 times in head and body. Toes 5-5. Fifth hind toe shorter than second, and free portion of longest toe a trifle over half of head. Of fore legs third and fourth longest. Color when fresh in alcohol muddy-brown above, this color on back bounded along each side by a dusky-brown or blackish longitudinal streak from nos-



Black Banded Lizard. *Leiopisma laterale* (Say).

trils along sides and fading out along sides of tail. This dark lateral streak bounded above and below, though narrowly, with pale brownish. Side of body below dark lateral streak with obscure dusky blotches extending from snout to tip of tail. Upper surfaces of limbs brownish, speckled with darker, and below whitish. Toes pale brownish below. Lower surface of body livid whitish, trunk with a somewhat greenish-blue tinge and tail with pale brownish-white tint. Eye brownish. Length $3\frac{1}{8}$ inches. Near Atsion, in Burlington County, September 2d, 1901. Mr. J. A. G. Rehn.

This little example is the only one I have seen. Mr. Rehn tells me that 2 others were noted at the same time, though not secured.

Lygosoma (Liolepisma) laterale J. P. Moore, Am. Nat., XXX, 1896, p. 752.

Liolepisma laterale Cope, Rep. U. S. Nat. Mus., 1898 (1900), p. 622 (from Moore).—Stone, Am. Nat., XL, 1906, p. 168.

Family IGUANIDÆ.

The Iguanas.

Teeth subequal. Pupil round. Eyelids well developed. Tongue thick, villous, nearly or quite entirely fixed to floor of mouth and little if at all notched in front. Teeth pleurodont, roots ankylosed to internal side of premaxillary and maxillary bones. Premaxillary not cut off from maxilla-palatines by maxillaries. Splenial well developed. Meckelian groove mostly closed. Angular little developed on inner, and much on outer side of ramus. Coronoid produced anteriorly, not posteriorly on outer face of ramus. Vertebrae procœlous. Scales various, those on head usually small, and latter generally with enlarged interparietal scale.

A large family of many species, with various habits, in tropical America. A single genus within our limits.

Genus SCELOPORUS Wiegmann.

The Pine Tree Lizards.

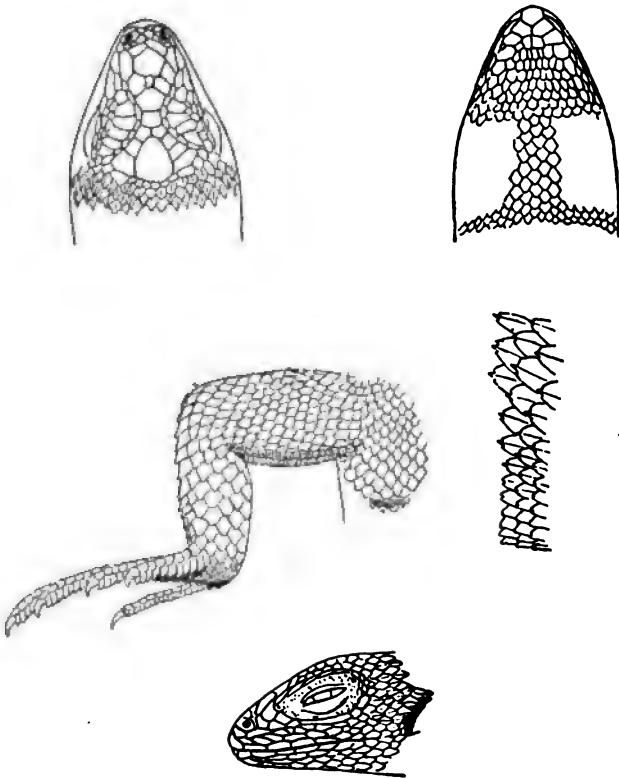
Sceloporus undulatus (Latreille).

PLATE 52.

Pine Tree Lizard. Fence Lizard. Common Lizard. Brown Scorpion. Swift. Pine Lizard.

Body long, depressed. Head and trunk $1\frac{1}{4}$ in tail. Head depressed and rather broad. Snout depressed, and tip bluntly rounded, mandible similar. Eye lateral, elongate, and a little nearer ear than tip of snout. Eyelids minutely scaly, movable.

Teeth minute. Interorbital space equal to gape. Ear smaller than eye, oblique. Scales firm, not especially hard, about 68 from tip of mandible to vent, and 60 more to tip of tail. About 42 scales transversely around middle of trunk. Cephalic plates largely smooth, especially in front and on sides of head, and others somewhat longitudinally rugose. Frontal plates 2, 1 before the other, anterior undivided, and with still another small



Pine Tree Lizard. *Sceloporus undulatus* (Latreille).

anterior 1 so arranged as to be surrounded by 4 cephalic plates. Supraorbital region with a crescentic series of 5 large transverse series, and embracing a short series of 3 or 4 additional outer and inner series of small plates in its concavity. Scales on back and rump about equal, smaller than those near base of tail. Lateral scales much smaller than dorsal. Dorsal scales angularly

pointed, well carinated, with conspicuous spines, and lateral denticulations indistinct. Scales on lower surface of body smooth and with 2 short points. Scales on inside of tibia distally and behind vent decidedly carinated. Femoral pores 16. Legs well developed, robust, posterior larger. When hind legs are applied forward they reach $\frac{3}{4}$ to tip of snout, and are contained $1\frac{3}{4}$ in head and trunk. Toes 5-5. First digit of each limb shortest, and free portion of fourth or longest digit of hind limb equals greatest width of head. Of fore limbs third and fourth longest. Color in alcohol of male more or less uniform brownish, with indistinct cloudings on back, and more distinct on tail where annulations are somewhat evident. Lower surface of body more or less pale or creamy-brown with some dusky specks here and there. Jaws pale brownish. Along each side of back and separated by about 10 rows of scales, a rather pale brown shade. Costal region dusky, more or less specked with pale brownish of back and with a pale median longitudinal obsolete streak. A deep ultramarine-blue blotch on each side of throat below ear fading into dusky-black, and this latter shade extending to shoulder. On each side of lower costal region a longitudinal deep blue patch fading along lower edge into dusky-black. Iris brownish. Length $6\frac{3}{8}$ inches. Point Pleasant. A. P. Brown and Witmer Stone.

Another example, a female, with the same data, differs, in alcohol, in the absence of the blue ventral patches, the body being more or less uniform in color below. The upper surface of the trunk is marked with about 9 deep brown somewhat zig-zag streaks.

This lizard, so characteristic of the pine-woods of New Jersey, was found commonly during Mr. Rehn's excursions, and more or less regularly distributed. They were quite abundant at Quaker Bridge. Mr. Rehn also reports several from near Clementon taken by Messrs. C. T. and G. M. Greene several years ago. Mr. Hartman of Palermo, Cape May County, reports that it is abundant in that locality. I have seen it near Medford. Dr. Abbott tells me that it was formerly found about Trenton, but has not been seen there for years, and is apparently rare.

It is reported to occur about Dennisville, in Cape May County, and be abundant, mostly on fences. Evidently it usually ranges little out of the pine-barrens region. When in captivity it is said to become tame. It feeds on insects which it captures about the bark of trees, rocks, or on fences. It is remarkably quick and agile in its motions, and is thus able to capture its prey with ease. Frequently it will remain perfectly motionless for a time, and then dart swiftly about, suddenly stopping and remaining quiet. Should one throw a stone the lizard only moves a short distance, though very suddenly. It don't appear at all afraid at times and will permit considerable bombardment before seeking cover, as I have noticed on several occasions when so attacked by boys. I have examined a number of examples from Tuckerton in October of 1893 (S. N. Rhoads), Camden and Atlantic Counties (Charles Liebeck), Point Pleasant (A. P. Brown and W. Stone), between High Bridge and East Plains in Burlington County on June 19th 1901 (W. Stone and J. A. G. Rehn), between Medford to the plains in Burlington County June of 1901 (W. Stone, H. L. Coggins and J. A. G. Rehn), Quaker Bridge in Burlington County in September of 1901 (W. Stone and J. A. G. Rehn), Staffords Forge in Ocean County and Cedar Grove near East Plains in Burlington County on June 2d 1905 (P. Lorrilliere), and some without definite locality obtained from Samuel Ashmead, which may have been taken near Beesley's Point.

Agama undulata Harlan, Journ. Acad. Nat. Sci. Phila., VI, pt. 1, 1829, p. 13 (ref. infers).—Harlan, Med. Phys. Res., 1835, p. 140 (copied).

Tropidolepis undulatus Holbrook, N. Am. Herp., III, 1838, p. 51, Pl. 8.—Holbrook, l. c., Ed. 2, II, 1842, p. 73, Pl. 9.

Sceloporus undulatus Abbott, Geol. N. J., 1868, p. 800.—Abbott, Nat. Rambles, 1885, p. 476.—Abbott, Pop. Sci. Month., XXXIV, 1889, p. 162, figs. —J. P. Moore, Am. Nat., XXX, 1896, p. 752.—Cope, Rep. U. S. Nat. Mus., 1898 (1900), p. 368.—E. Smith, Proc. Linn. Soc. N. Y., 1898-1899, No. 11, p. 20.—Stone, Am. Nat., XL, 1906, p. 168.

Order TESTUDINATA.

The Turtles.

Body enclosed between 2 more or less developed bony shields which are usually covered by horny epidermal plates and sometimes by a leathery skin. Upper shield or carapace, and lower shield or plastron, more or less united along sides. Neck and tail only flexible parts of spinal column, and these together with legs usually retractile within box made by shields. No teeth, edges of jaws encased in horny sheaths usually with sharp cutting edges. Eye furnished with 2 lids and a nictitating membrane as in birds. Tympanic membrane always present, though sometimes hidden by skin. Respiration effected by swallowing air. Bony part of carapace formed by dorsal and sacral vertebræ and ribs co-ossified with a series of underlying bony plates, usually accompanied by a marginal row. Dorsal vertebræ with their ends flattened and immovably united by cartilage, and all except first and last with neural spines flattened horizontally so as to form median line of plates. On either side of this series a single row of ossified dermal plates overlying ribs, and corresponding in number to developed ribs, of which there are usually 8 pairs. No true sternum. Plastron consisting of membrane bones, usually of 9 pieces, as 4 pairs and a single symmetrical median piece. Osseous plates both above and below correspond neither in number or position with overlying dermal plates. Quadrate bone immovably united to cranial arches. Anal opening round or longitudinal. Copulatory organ present, single.

Key to families.

- a. Limbs developed as paddles, not capable of distinct movements at wrist or ankle-joint; digits flattened, elongated, bound immovably together by integument; sea turtles.

b. Feet scaleless, anteriorly large; carapace elongate.

DERMOCHELIDÆ

bb. Feet scaly; carapace heart-shaped.

CHELONIIDÆ

- aa. Limbs not in form of paddles, capable of movement at wrist and ankle-joint; land and pond turtles.
 - c. Carapace leathery, its margin flexible; no dermal plates; toes 5-5, claws 3-3; head small; snout pointed; body very flat. *TRIONYCHIDÆ*
 - cc. Carapace firm, ossified; dermal plates present; claws mostly 5-4.
 - d. Fingers and toes spreading, not closely bound together, and more than 1 joint free.
 - e. Tail very long and strong, crested with tubercles; plastron narrow and small, cross-shaped, and with 9 plates beside bridge; head large; body highest in front. *CHELYDRIDÆ*
 - ee. Tail short, not crested; plastron broad.
 - f. Lower jaw ending in long sharp point; carapace highest behind middle, and its edge not flaring outward; plastron with 9 or 11 plates. *KINOSTERNIDÆ*
 - ff. Lower jaw without long point at symphysis; carapace highest about middle, and its edge flaring outward; plastron with 12 dermal plates. *EMYDIDÆ*

Family *DERMOCHELYDÆ*.

The Leather Turtles.

Carapace with several longitudinal ridges with deep grooves between, completely osseous, and 7 in number in adult. Plastron incompletely osseous and with 5 keels. Body highest in front, and widest just before bridge. Head short, high and very broad behind. Upper jaw with 2 pits and 2 tooth-like projections. No enlarged alveolar surface, jaws simply sharp-edged. Exoskeleton consisting of mosaic-like juxtaposed plates. Skull without descending processes to parietals. Vertebrae and ribs free, separated from bony exoskeleton. Plastral elements 8. No entoplastron. Body covered with a smooth leathery skin. Head covered with small shields. Limbs paddle-shaped, clawless, and digits of fore limb much elongated. Hind limbs much exposed. Phalanges without condyles.

One genus, with a single species, widely distributed in warm seas, and among the largest of turtles.

Genus *DERMOCHELYS* Blainville.

The Leather Turtles.

Dermochelys coriacea (Vandell).

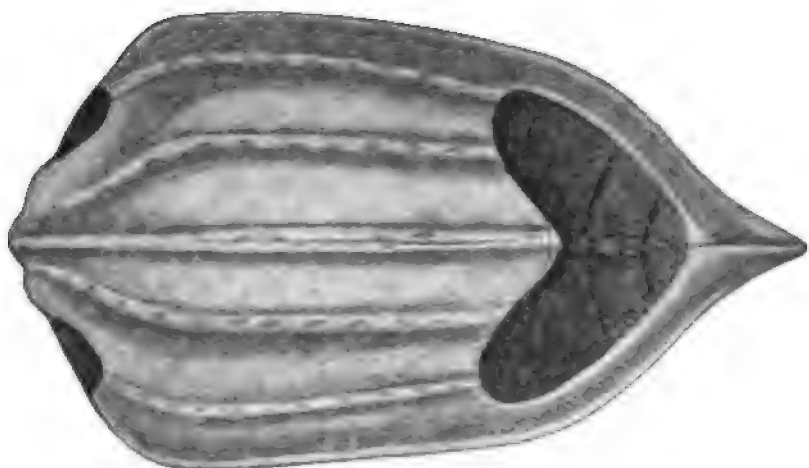
PLATE 53.

Leather Turtle. Trunk Back. Sea Turtle.

Carapace sub-cardiform, broadest about first fourth of its length, and evenly convergent from this point to median tip posteriorly. Longitudinal keels distinct, 7 in number, and converging evenly behind to posterior tip of carapace. Median keel pronounced, more so than each dorso-lateral, then next below on sides less so, and even lateral margin similarly indistinct. Each of keels becoming more or less unevenly jagged posteriorly, though serræ so formed rounded, and more or less knob or tubercle-like. Median 3 keels more widely separated anteriorly, very trenchant and elevated at front of carapace. In anterior parts of course, space between dorso-lateral and infero-dorsal keels greater than greatest width between any of keels. Entire surface, otherwise than noted, perfectly smooth. In profile body apparently deepest antero-medially, as back is apparently depressed accidentally at this point. Lateral keels on plastron apparently obsolete, others not seen. Head large, cylindrical basally, and as viewed above rather elongately triangular. Sides of head somewhat compressed, and upper surface more or less evenly convex. Snout blunt and obtuse in profile. Eye moderate, anterior. Jaws large, strong, and upper with 3 deep notches in front. Mandible recurved in front. Edges of jaws sharp. Nostrils near together on front of snout above. Inter-orbital space convex. Neck short and thick, especially at base. Skin all more or less smooth. Fore limbs long and falcate, twice as long as hind pair, fin-like, compressed strongly and becoming a little broader basally. Hind limbs of similar shape, only shorter and broader, and each with a broad cutaneous flap

along posterior edge. Tail short, extending but slightly beyond carapace, and with a rather broad median cutaneous ridge on outer $\frac{2}{5}$ of its length. Color of dry specimen dull blackish. Length about 6 feet. Delaware Bay. E. D. Cope.

This, among the largest of all marine turtles, is said to reach 8 feet in length, and is occasionally found along our coast. Mr. Wm. J. Fox reports a large turtle, evidently this species, captured in the pounds and exhibited in 1903 at Wildwood, Cape May County. It was said to have weighed 1,200 pounds. Capt. Ludlam reports one from near Stone Harbor washed ashore about the same time. I have also examined the carapace of a



Leather Turtle. *Dermochelys coriacea* (Vandelli). (Shell below.)

large example obtained at Asbury Park some years ago by Mr. David McCadden.

Sphargis coriacea Holbrook, N. Am. Herp., Ed. 2, II, 1842, p. 45, Pl. 6.—Agassiz, Contrib. Nat. Hist. U. S., I, 1857, p. 373.—Ford, Am. Nat., XIII, 1879, p. 633.

Testudo coriacea Gerard, Am. Nat., XIV, 1880, p. 129.

Dermochelys coriacea E. Smith, Proc. Linn. Soc. N. Y., 1898-99, No. 11, p. 12.—C. H. Townsend, Bull. N. Y. Zool. Soc., April 1904, p. 143.—Stone, Am. Nat., XL, 1906, p. 168.

Family CHELONIIDÆ.

The Logger Head Turtles.

Carapace depressed, heart-shaped, broad, flat, highest in front, widest near middle, and covered with bony plates. Head large, subquadrilateral, and covered with plates. Neck bending by sigmoid curve in vertical plane, short, thick, and incompletely retractile. Jaws without tooth-like projections. Parietals prolonged downwards forming a suture with pterygoids, or separated from latter by interposition of epipterygoid, and in contact with squamosal, and latter also forming suture with parietal. Pterygoids in contact in median line, narrow in middle. Nuchal plate without costiform processes. Mandible with articular concavities. Outer border of tympanic cavity deeply notched. Mandible with articulatory concavities. Temple completely roofed over. Dorsal vertebræ and ribs immovably united and expanded into bony plates forming carapace. A complete series of marginal bones connected with ribs. Cervical vertebræ without or with mere indications of transverse processes, short, and mostly articulated by amphiarthrosis. Centrum of last cervical articulating with that of first dorsal. Caudal vertebræ procœlous. Plastral bones 9. Epiplastra in contact with hypoplastra. Entoplastron if present oval, rhomboidal or T-shaped. Pelvis not anchylosed to carapace and plastron. Limbs paddle-shaped. Phalanges without condyles. Claws 1 or 2.

Among the largest marine turtles in the open seas, visiting the shore only to deposit and bury their eggs. Two genera are represented along our coast.

Key to the genera.

- a. Head broad; edge of lower jaw not serrate; scales around large median plate on top of head 13 to 20; costal plate 5 on each side. CARETTA
- aa. Head high and narrow; tomia of lower jaw serrate; scales around vertical plate 7; costal plates 4. CHELONIA

Genus CARETTA Rafinesque.

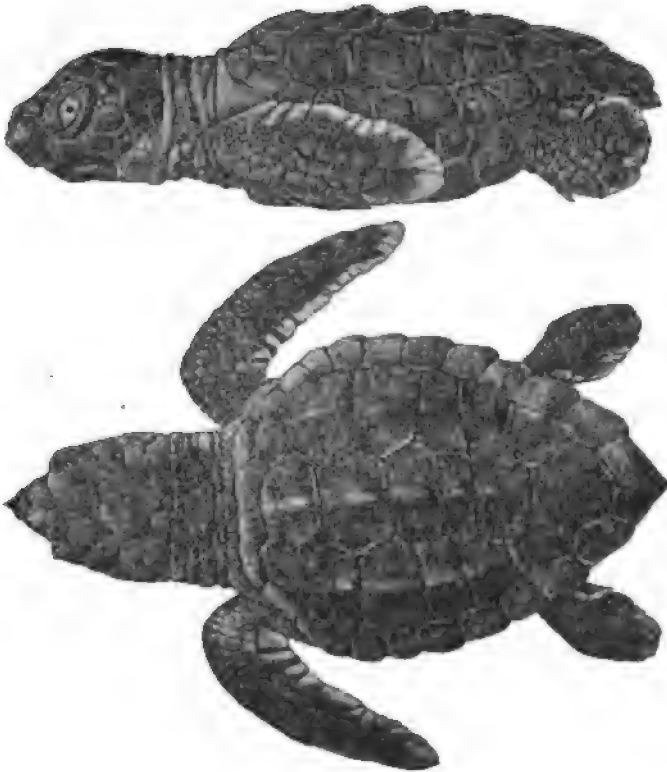
The Logger Head Turtles.

Caretta caretta (Linnæus).

PLATE 54.

Logger Head Turtle. Sea Turtle. Turtle.

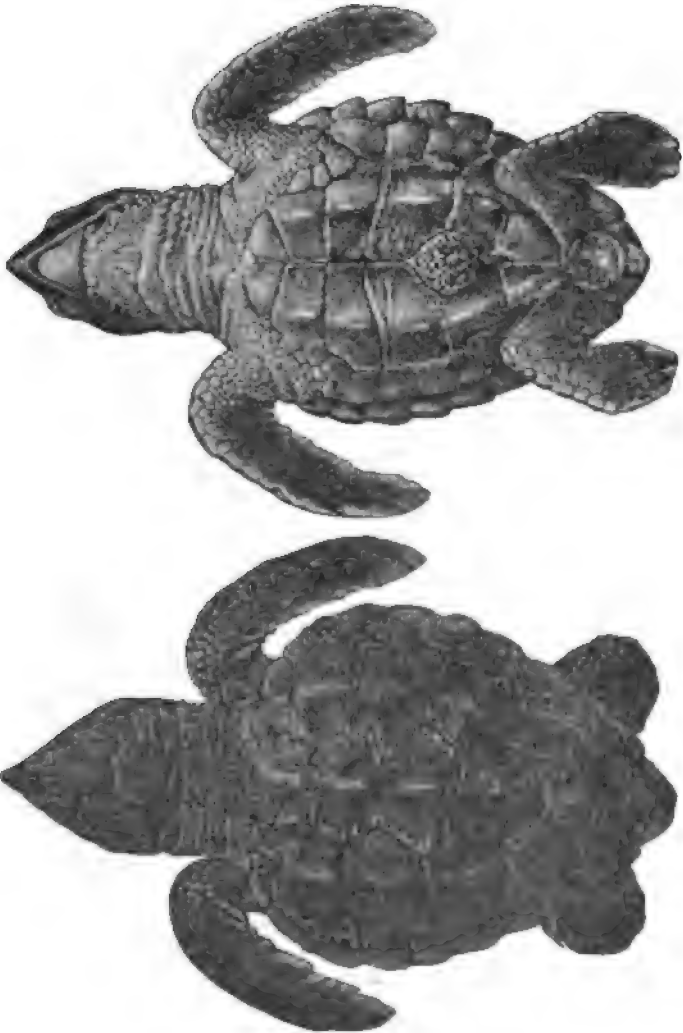
Carapace of young with 3 strong keels, in adult arched or subtectiform. Dorsal shields juxtaposed. Margin of carapace



Logger Head Turtle. *Caretta caretta* (Linnæus). (Young.)

serrated behind in young, and of 25 to 27 shields. Intergular shield very small or absent. Head large, with very strong hooked jaws. Symphysis of mandible very long. Alveolar surface of

horny beak with a median ridge, of jaws without. Shields in 2 pairs anterior to azygous frontal. Limbs of young usually with 2 claws, frequently but 1 in adult. Adult brown above,



Logger Head Turtle. *Caretta caretta* (Linnæus). (Young.)

yellowish below, and young uniform dark brown or blackish. (Boulenger.)

This large turtle, distinguished from our other species chiefly

by the non-imbricated dorsal plates and 2 nails to each foot, is apparently subject to great variation. It is said to reach 1600 pounds in weight. Mr. Wm. J. Fox reports an example taken off Sea Isle City, in the pounds, early in July of 1905. It was said to have weighed about 400 pounds. I saw a carapace of this species at Stone Harbor on July 25th, 1906, which had washed ashore sometime previously. Mr. C. H. Townsend records a 400 pound example taken in New York Bay at Belford, in Bull. N. Y. Zool. Soc. for October of 1906. Though I have no reports of these animals breeding within our limits a pair is said to remain copulating for as many as 17 days at a time. They are said to feed largely on conches, which are readily crushed by their powerful jaws. The large sea turtles which occasionally enter Delaware Bay are usually this species. They have been found about the pounds off Green Creek and Dias Creek in Cape May County. Some have been reported from there as quite large, sometimes of several hundred pounds weight. They were sold as food by the fishermen. Off Cape May, Anglesea and Stone Harbor, fishermen have reported them from the open sea, sometimes many miles off shore. They usually were floating along on the surface of the waves, either asleep or quietly resting.

Chelonia caretta Holbrook, N. Am. Herp., Ed. 2, II, 1842, p. 33, Pl. 4.

Thalassochelys caretta E. Smith, Proc. Linn. Soc. N. Y., 1898-99, No. 11, p. 12.

?*Amyda mutica* Abbott, Geol. N. J., 1868, p. 799.

Genus CHELONIA Latreille.

The Green Turtles.

Chelonia mydas (Linnæus).

PLATES 55 (UPPER VIEW) AND 56 (LOWER VIEW).

Green Turtle. Sea Turtle.

Carapace feebly unicarinate in young, sometimes with slight indication of lateral keels, and arched or subtectiform in adult. Dorsal shields juxtaposed. Margin not or but indistinctly ser-

rate, formed of 25 shields. Snout very short. Jaws not hooked. Horny sheaths of upper jaw with feebly denticulated edge, and striated inner surface of lower jaw with strongly denticulated edge. Alveolar surface of lower jaw with 2 denticulated strong ridges. Symphysis of mandible short. One pair of prefrontal shields. Limbs usually with a single claw. Second digit sometimes provided with a distinct claw in young. Young dark brown or olive above, limbs margined yellow. Yellow below with a large dark brown spot on hand and foot. Carapace of adult olive or brown, marbled or spotted with yellowish. (Boulenger.)

This turtle is sometimes taken along our coast and is of value as food. Though most of the examples are usually small the species is said to reach a weight of 1,000 pounds. I saw an example at Anglesea during September of 1897. Mr. J. A. G. Rehn says he has seen it at Atlantic City, and also seen them swimming at sea at the surface of the water. It does not seem to breed along our shores, and in fact I have not heard of the eggs of any of our large sea turtles having been found there. It is herbivorous. Like the logger head it is most abundant in the tropical seas, visiting the sandy shores only to deposit its eggs. It feeds mostly in deeper water. The œsophagus of this turtle is lined with a number of curious long pointed light processes directed towards the stomach, which are probably of service in retaining its food.

Chelonia mydas Agassiz, Contrib. Nat. Hist. U. S., I, 1857, p. 378.—E. Smith, Proc. Linn. Soc. N. Y., 1898-99, No. 11, p. 13.

?*Aspidonectes spinifer* Abbott, Geol. N. J., 1868, p. 799 (part).

Family TRIONYCHIDÆ.

The Soft Shelled Turtles.

Body flat, nearly orbicular. Carapace not completely ossified, ribs projecting freely towards outer extremities. Carapace and plastron without epidermal shields. Head long and pointed. Jaws concealed under fleshy lips. Snout long, flexible, tubular and pig-like, ending in a proboscis. Ear hidden. Head and

neck completely retractile, latter long and bending in a sigmoid curve in a vertical plane. Dorsal vertebræ and ribs immovably united and expanded into bony plates forming a carapace. Parietals prolonged downwards, forming a suture with pterygoids or separated from latter by interposition of epipterygoid. Pterygoids broad throughout, separated from each other, and basisphenoid joining palatines. Mandible with articular concavities. Outer border of tympanic cavity notched. Cervical vertebræ without transverse processes. Articulation between last cervical and first dorsal vertebra by zygapophyses only. Pelvis not anchylosed to carapace and plastron. Epiplastra separated from hyoplastra by ^-shaped entoplastron. Marginal bones absent or forming an incomplete series, not connected with ribs. Feet broadly webbed. Toes long, 5-5, and claws only 3-3. Fourth digit with 4 or more phalanges.

Fierce aquatic carnivorous voracious turtles in the rivers of Asia, Africa and North America, constituting rather a large family. A single genus within our limits.

Genus *ASPIDONECTES* Wagler.

The Soft Shelled Turtles.

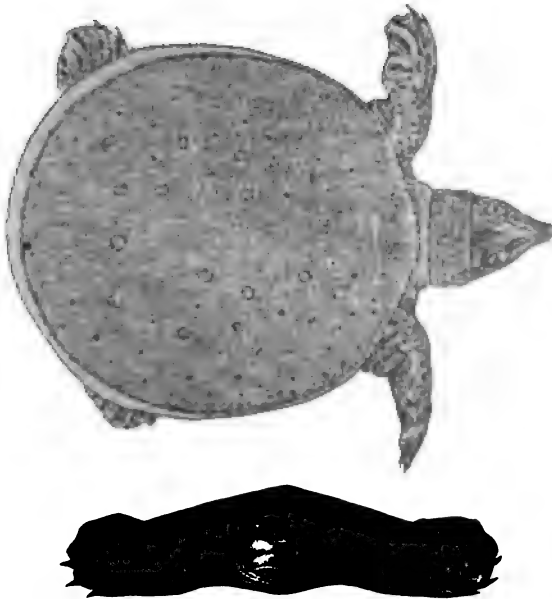
Aspidonectes spinifer (Le Sueur).

PLATE 57.

Common Soft Shelled Turtle.

Carapace broadly oval as viewed above with greatest width about last $\frac{3}{7}$ of its length, entire, greatly depressed, and scarcely carinate, edges more or less soft in comparison. Anterior margin of carapace would form a very obtuse triangle with apex at nape of neck. Carapace when viewed laterally with greatest depth about third vertebral plate, and posterior descent of profile much more gradual than anterior, which is rather abrupt. Median vertebral keel obsolete, broadly convex, and only developed

anteriorly. Posterior surface of carapace flattened. Lateral carina formed by carapace, much more firm than its posterior margin, and also jutting out well. Bridge of carapace rather narrow. Upper surface of carapace finely prickly or roughened to touch, and asperities few and small on outer radius. Lower edge of carapace perfectly smooth, like entire lower surface of body. Plastron similar to carapace anteriorly, where it is cartilaginous and retractile. Its formation with bony part forms broad lateral ridge, cartilaginous portion of which is greater than osseous. Without bony bridge rest of bony plastron more or



Common Soft Shelled Turtle. *Aspionectes spinifer* (Le Sueur). (Young.)

less ellipsoid, with width about $1\frac{1}{3}$ in its length. Length of bony plastron about half length of carapace. Head large, elongately oval and attenuated, more depressed below. Snout conic, produced into a cylindrical fleshy proboscis well beyond end of mandible. Eye moderate, high and prominent. Mouth large, horny or firm in front, and with entire jaws, lower fitting in upper. Lips large, thick and fleshy along sides of each jaw. Nostrils as 2 adjoining tubes at tip of produced snout, and rounded. Interorbital space a little concave. Head and neck

moderately distensible, and wrinkled skin on neck in large thick folds. Legs, feet, tail and exposed portions of limbs covered with thick skin. Anterior limb with 3 large transverse scales at wrist externally, and its posterior edge flattened into a thick tough membrane supported by 2 outer cartilaginous digits, which have no claws. Posteriorly membrane supported by 2 scales like those on fore arm. Inner 3 fingers with strong claws. Hind limbs large, soles broadly expanded with membranous margin similar to fore limb. Claws however much more slender and with innermost largest. Only a single scale supports posterior membrane of hind limb. A horny scale at keel. Tail conic, robust, depressed above, laterally with fleshy keel from hind limbs continued out near its conic short pointed tip, and short in length or passing but slightly beyond carapace. Color in alcohol dull olivaceous-umber on carapace above, marked rather sparsely with black-edged irregular-sized ocelli, smaller ones all external. Plastron pale creamy or brownish-white, bony regions more or less showing through as livid areas. Upper surface of head and limbs colored dull slaty-gray, becoming paler and livid below to creamy of plastron. Upper surfaces also finely speckled, reticulated or vermiculated with olivaceous-slaty or dusky, or umber. A dilute yellowish blotch along each side of head above and behind eye margined narrowly blackish. Iris dull slaty-gray. Length about 9 inches with distended snout to tip of tail. Coopers Creek. May, 1902. Dr. H. C. Chapman.

The soft shelled turtle has been recorded from Paulins Kill at Hainesburg in Warren County, and Woodbury, by Cope in the American Naturalist, XXVIII, 1894, p. 889. Dr. Abbott tells me that 2 or 3 were found as early as the late sixties. They were introduced when young and apparently to stock aquaria. It is more a feature of the inland waters of the eastern United States.

Aspionectes spinifer Abbott, Geol. N. J., 1868, p. 799.—Stone, Am. Nat., XL, 1906, p. 168.

Family CHELYDRIDÆ.**The Snapping Turtles.**

Carapace high in front, low behind, covered with epidermal shields, comparatively small and with serrated posterior border. Neural plates broader than long, forming a complete series. Pygals 1 or 2. Marginal plates 23. Plastron small, cruciform, and with 9 plates besides very narrow bridge, and articulating with carapace by gomphosis. Abdominal shields not meeting on median line, separated from marginals by a series of infra-marginals. Shell attains complete ossification but late in life. Head and neck very large. Neck bending in a sigmoid curve in a vertical plane, completely retractile. Jaws strongly hooked and powerful. Chin with 1 or more pairs of small dermal appendages. Parietals prolonged downwards, forming a suture with pterygoids, or separated from latter by interposition of epipterygoid. Pterygoids narrow in middle, in contact on median line. Nuchal plate with long costiform processes underlying marginals. Outer border of tympanic cavity deeply notched. Mandible with articular concavities. Temporal region incompletely roofed over, no parieto-squamosal arch. Squamosal widely separated from parietal. Dorsal vertebræ and ribs immovably united and expanded into bony plates forming carapace. A complete series of marginal bones connected with ribs. Cervical vertebræ without or with mere indications of transverse processes. Centrum of last cervical articulating with centrum of first dorsal, second and third opisthocœlous, fourth amphicyrtous and rest procœlous. Caudal vertebræ mostly opisthocœlous. Epiplastra in contact with hyoplastra. Entoplastron, if present, oval, rhomboidal, or T-shaped. Pelvis not anchylosed to carapace and plastron. Pubic symphysis widely separated from ischial. Phalanges with condyles. Claws 5-4, strong, outer toe clawless, and web small. Tail long, crested above.

Large fierce and powerful turtles of great strength and voracity. A single genus and species within our limits.

Genus CHELYDRA Schweigger.

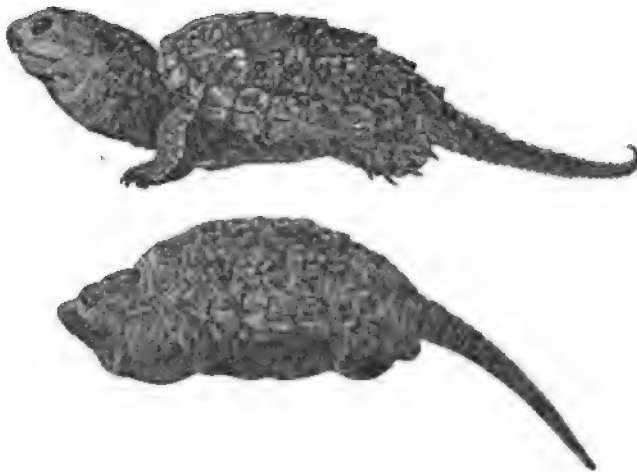
The Snapping Turtles.

Chelydra serpentina (Linnæus).

PLATE 58.

Snapping Turtle. Snapper. Logger Head. Logger Head Turtle.

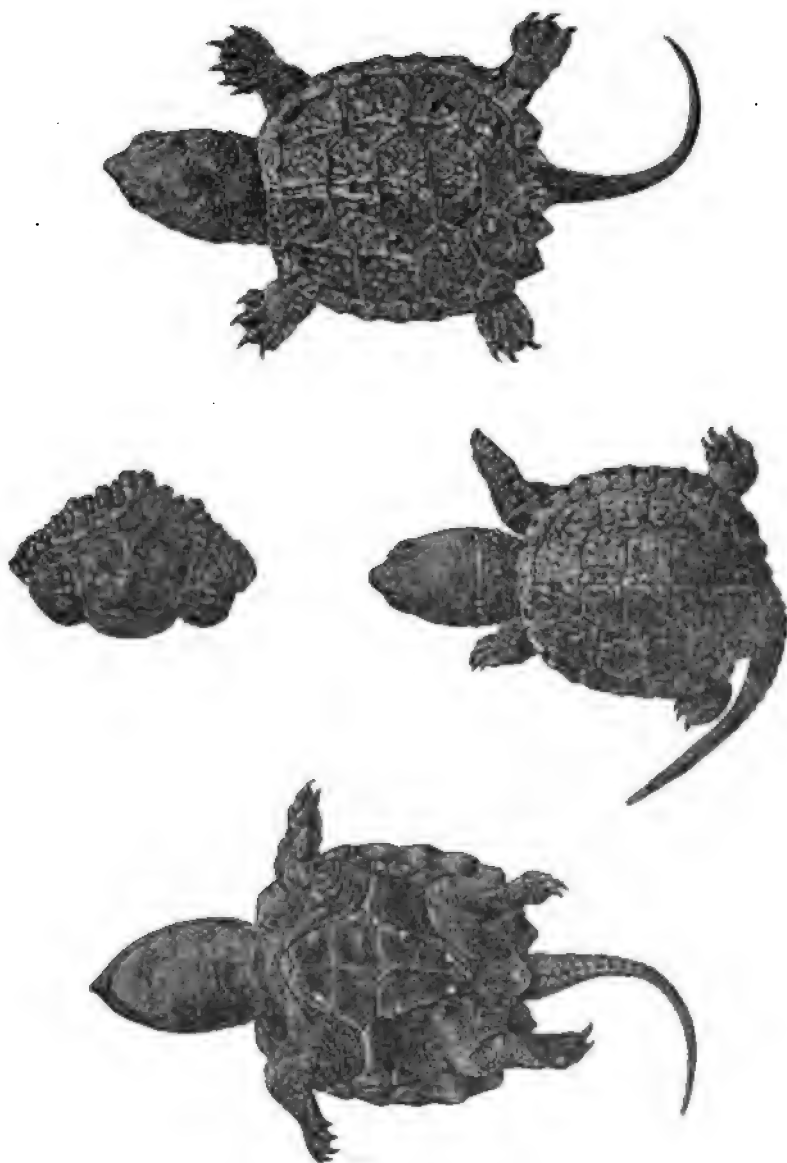
Carapace broad, slightly oval, as viewed above, with greatest width about opposite fourth vertebral plate or last fourth of its

Snapping Turtle. *Chelydra serpentina* (Linnæus). (Young.)

length. In form smaller, entire in front, and serrated behind. First 2 vertebral plates broadly octagonal and widest of series. Posterior margin of first vertebral plate slightly notched to receive second, others following with posterior borders slightly concave. Second lateral plate largest. Marginal plates all small anteriorly and narrowly elongate, but becoming broad and with distinct angles along hind edge. Down middle of back each median vertebral plate has an elevated osseous crest which forms

a double series of tubercles, a pair to each plate, and these situated mostly at their posterior portions. Along each of lateral plates a single series of tubercles. Entire upper surface of carapace more or less entirely with bony tubercles. Posterior marginal plates more or less striate. In profile carapace highest at second vertebral plate, and posterior to this point margin below a more gradual even convex curve up posteriorly than anteriorly. Marginal plates below all more or less smooth. A very small axillary plate. Plastron cruciform without narrow bridges, ovoid in shape with bulge anterior and posterior, and convergence decidedly narrower. First pair of gular plates small and apical, brachial triangular, and broad thoracic largest. Abdominals triangular, and subcaudals elongate to form an isocles triangle. Plates on plastron all smooth and without striæ. Head very large, flattened above and broad behind, appearing rather narrowly triangular as seen from above. Snout pointed and short. Eye large, high, prominent and near end of snout. Mouth inferior, with upper jaw projecting well beyond lower, and with a notch on each side in front. Mandible fitting within upper jaw and hooked well in front. Mouth as viewed below with width about $1\frac{1}{4}$ in its length. Head and neck distensible for a space about equal to $\frac{3}{4}$ length of carapace, latter thick, and covered both above and below with warty or tuberculated skin, forming a fold on retracted head. Legs, feet and tail covered with similar skin, more or less tuberculated posteriorly, and transverse rows of large scales both above and below on latter. Some large scales on outer front, or wrist, of fore limbs. Fore limbs large, robust, and each of 5 fingers with a slender curved claw. Hind limbs equally strong, and well developed, and 5 toes with similar claws. Tail long and slender, ending in a narrow pointed tip, and with a median series of wedge-shaped keels along its dorsal surface, decreasing in size posteriorly. On each side of tail a series of tubercles above, and another below, similarly decreasing backwards. Behind vent about 4 of plates bifid as in some snakes. Color in alcohol dusky-brown above. Limbs and tail all more or less dusky-gray, paler or more grayish below, and each finely specked or obscurely spotted with grayish-white.

Marginal plates below, and bridge, brownish. Plastron more or less dusky-brown, with a number of whitish spots. Claws horny-



Snapping Turtle. *Chelydra serpentina* (Linnæus).

brown. Iris dull slaty. Length $4\frac{1}{4}$ inches. Cedar Swamp Creek at Petersburg, Cape May County. April 16th, 1906. T. D. Keim and H. W. Fowler.

About Trenton this species is abundant according to Dr. Abbott. The largest example which came under his notice weighed 62 pounds. They feed largely upon fish, and at times apparently under water. In Cedar Swamp Creek they are reported as abundant, and are the object of pursuit to the farmers. Dr. J. P. Moore reports that an example was aroused from hibernating during the warm spell of January of 1906, and was active, near Woodbury. Mr. G. Z. Hartman reports it abundant about Palermo, Cape May County, during April of 1906. Abundant about Dennisville in Cape May County. During September of 1906, large ones were observed, 1 of about 11 pounds weight, and the other about 9. They are more highly prized as food by the inhabitants than the other species. When fattened in swill a short time they soon increase in size, and are then considered best. In coloration they seemed to agree with those of our more northern districts, though their shells were covered above with a good coating of greenish moss. After fattening, the lower surface of the body, such as the limbs, tail and neck, assumes a more swollen appearance and a pale creamy-white tint. They are, however, ever with a vicious or ferocious disposition, snapping or fiercely biting at anything placed in their way.

Chelonura serpentina Say, Journ. Acad. Nat. Sci. Phila., IV, pt. 2, 1825, pp. 206, 217 (ref. iners).—Harlan, Journ. Acad. Nat. Sci. Phila., VI, pt. 1, 1829, p. 31 (ref. iners).—Holbrook, N. Am. Herp., IV, 1840, p. 21, Pl. 3 (ref. iners).—Holbrook, l. c., Ed. 2, I, 1842, p. 139, Pl. 23.

Chelydra serpentina Harlan, Med. Phys. Res., 1835, p. 157 (copied).—Agassiz, Contrib. Nat. Hist. U. S., I, 1857, p. 417.—Abbott, Geol. N. J., 1868, p. 799.—Abbott, Nat. Rambles, 1885, p. 475.—E. Smith, Proc. Linn. Soc. N. Y., 1898-99, No. 11, p. 15.—Stone, Am. Nat., XL, 1906, p. 169.

Family KINOSTERNIDÆ.

The Musk Turtles.

Carapace rather long and narrow, outline usually rising gradually from front to a point beyond center of shell, then abruptly descending, and bulk of body therefore thrown backward. Margin of carapace turning downward and inward rather than outward. Plastron proportionately large, covered with horny plates, anterior pair coalescing into 1. Anterior and also sometimes posterior lobe of plastron, often movable upon fixed central portion. Shell covered with epidermal plates. Head pointed. Neck completely retractile within shell, and bending by a sigmoid curve in a vertical plane. Eyes far forward. Jaws usually strong. Parietals prolonged downwards, forming a suture with pterygoids, or separated from latter by interposition of epipterygoid. No parieto-squamosal arch, squamosal widely separated from parietal. Pterygoids narrow in middle, in contact on median line. Temporal region not roofed over. Mandible with articular cavities. Outer border of tympanic cavity deeply notched. Nuchal plate reduced to costiform processes underlying marginals. A complete series of marginal bones connected with ribs. Dorsal vertebræ and ribs immovably united and expanded into bony plates forming carapace. Cervical vertebræ without or with mere indications of transverse processes, and centrum of last articulating with centrum of first dorsal. Caudal vertebræ procœlous. Plastral bones 8, entoplastron absent, and epiplastra in contact with hyoplastra. Pubic and ischial symphyses in contact, separating 2 foramens, and pelvis not ankylosed to carapace and plastron. Digits with not more than 3 phalanges, which are furnished with condyles. Limbs slender, feet short, and claws 4 or 5.

Small turtles mostly in tropical and temperate America. Two genera in our limits.

Key to the genera.

- a. Carapace without traces of median keel in adult; head moderate; plastron with anterior and posterior lobes nearly equal in length, both freely movable and capable of closing shell; posterior lobe emarginate behind, its angles rounded.

KINOSTERNON

- aa. Carapace more or less keeled, at least when young; head very large, with strong jaws; plastron with its posterior lobe longer than anterior, truncate behind, and its posterior angles not rounded; lobes of plastron little movable, incapable of closing shell.

TERRAPENE

Genus KINOSTERNON Spix.

The Mud Turtles.

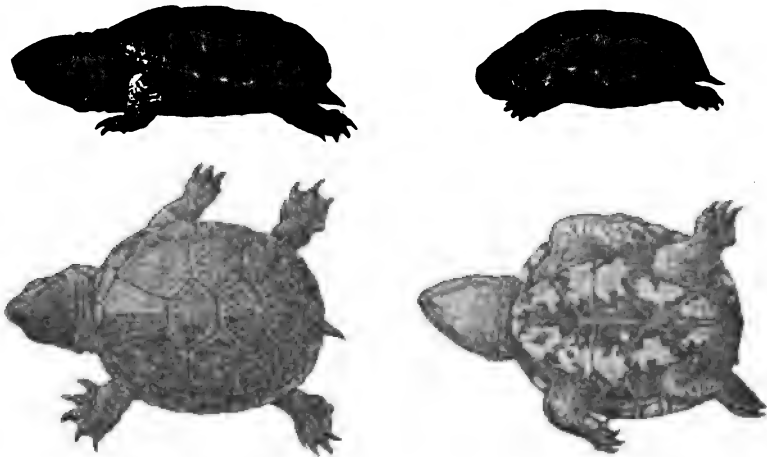
Kinosternon pensylvanicum (Gmelin).

PLATE 59.

Mud Turtle. Mud Digger. Musk Turtle.

Carapace slightly ovoid as viewed above, with greatest width about first third in its length, or about opposite middle of second vertebral plate. Anterior margin of carapace barely indented. Carapace when viewed laterally with greatest depth about third vertebral plate, and posterior descent of profile much more strongly convex than anterior, which slopes gradually down in front. Median vertebral keel broad, obsolete, and hardly defined. Posterior surface of carapace abruptly vertical, and marginal plates also all sloping down, none jutting out, though those along anterior edge a little more obliquely inclined. Lower edge of carapace as seen in profile posteriorly straight, and laterally slopes gradually up forwards, at first somewhat convex till nearly horizontal a short space before neck. Two plates forming bridge of plastron deepest at their articulation, so that their length would be $\frac{3}{4}$ their depth. Axillary plate narrowly exposed. Inguinal plate large and elongate. Plates of carapace smooth or with only very obsolete traces of striæ. Plastron ovoid, with a marked constriction just behind bridge, so that greatest width would fall near first third of its length or just before bridge. Front of plastron convex, and each side converging back towards bridge convexly. After constriction just posterior to bridge, each side of plastron bulges out with a notch at junctions of femoral and anal plates, and also a triangular one medianly at junction

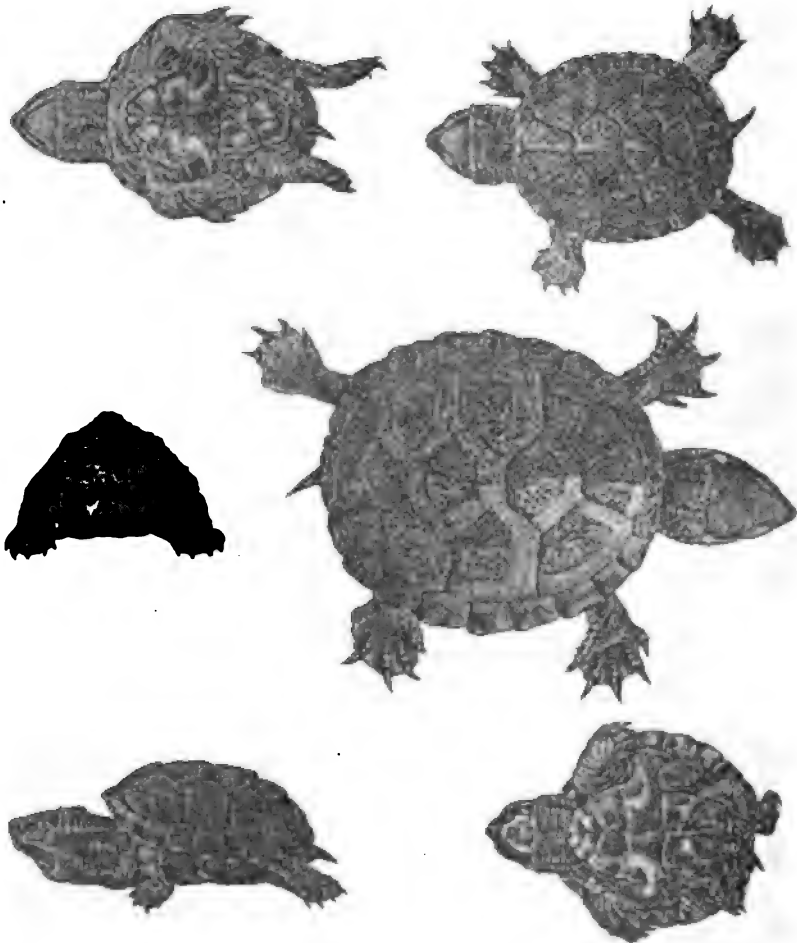
of each anal. Plates on plastron all with more or less angulated striæ. Head large, heavy, depressed both above and below, and with swollen appearance posteriorly. A marked depression on middle of head above, and each side swollen convexly. Snout obtusely protruding, nearly equally as long as broad, and in profile sloping down inferiorly or towards throat. Eye moderate, socket about $4\frac{1}{2}$ in head to occiput, or a little longer than snout, lateral, and a little longer than deep. Mouth oblique, inferior, edge of upper jaw shutting over lower all around, so that mandible is inferior and with convex surface. Upper jaw hooked in front. Edges of jaws sharp and horny, and when closed gape



Mud Turtle. *Kinosternon pensylvanicum* (Gmelin). (Young.)

appearing with a notch in front behind hook of upper jaw, and then convex, with bulge down. Mouth as viewed below $\frac{3}{4}$ as long as wide. When viewed above profile of head would form a more equilateral triangle. Head and neck distensible for space equal to $\frac{3}{5}$ length of carapace, and wrinkled skin on neck forming a fold on retracted head. Legs, feet and tail covered with soft skin and some few weak scales or scale-like tubercles. Scales perhaps best developed and strongest on soles and palms. A few large scales at bases of fingers and toes above. No scales on tail above. Limbs short, strong, and hind pair a trifle smaller. Claws 5 on each front pair, and 4 on each hind pair. Those on

width, and posterior descent of profile much more steep than more oblique anterior. Median vertebral keel rather narrow and trenchant, carpace sloping steeply down on each side though posterior surface not more steep than elsewhere, and marginal



Musk Turtle. *Terrapene odorata* (Latreille). (Young.)

plates nowhere jutting out, those just after bridge slightly more depressed outwards than others. Lower edge of carapace as seen in profile slopes gradually and more obliquely up from just after bridge, and posteriorly but slightly. Posterior plate forming

bridge of plastron deep, and much larger than anterior. Plates on carapace all more or less finely and obsoletely striate, sutures prominent, and median keel sharp, otherwise smooth. Plastron cruciform, much smaller than carapace or its length about $1\frac{1}{2}$ in latter, and with large lateral processes of abdominal forming bridge rather broad. Without bridges form of plastron elongately-ovoid, and bulge at front of bridges greatest width or about half its length. Gular plate small, single. Branchial plates small, 2, and much smaller than thoracic. Abdominal largest of all plates. Femoral subtriangular, and subcaudal quadrilateral. Free edges of plastron notched at sutures, and an emargination at posterior edge of subcaudals. Plates of plastron all with more or less angulated striæ. Head large, depressed both above and below, and with swollen appearance posteriorly so that it is elongately oval as viewed above, with anterior convergence ending in sharp-pointed snout. Eye large, high and anterior. Mouth slightly undulated, inclined slightly posteriorly, upper jaw projecting well beyond lower, and shutting outside. Upper jaw strong and sharp-edged, and lower equally strong and recurved in front. Mouth as viewed below $\frac{3}{4}$ long as wide. Head and neck distensible for about $\frac{4}{7}$ length of carapace, forming fold over head when retracted, and wrinkled skin on head and neck covered with fleshy tubercles or points. Legs, feet and tail covered with soft skin. Fore limbs with 3 large scales on carpus above, and a number of small ones over bases of fingers. A few scales over bases of hind toes above. Tail not scaly. Fore limbs short, rather robust, and each of 5 fingers with a short curved claw. Hind limbs compressed at tarsus, and with 5 toes, of which only 4 inner have claws similar to those on fingers. Tail robust, pointed, conic, short, thick at base, and ending in a horny point. Color in alcohol with carapace dusky-olive, scarcely mottled with darker. Plastron soiled brownish. Head dull blackish above, and same general ground-color extends below. A pale or whitish streak from tip of snout above over eye and back towards carapace. Below this a still more pronounced similar-colored streak begins on snout below and extends back on neck below eye. Still another equally as distinct on side of mandible,

but not extending on neck. On wrinkled skin of neck, lines longitudinally, made up of spots on tubercles, extend to number of about 10. Feet and legs all grayish mottled horn-color and spotted with brownish and paler. Iris slaty. Length about $3\frac{1}{2}$ inches. Mare Run, tributary of the Great Egg Harbor River, at May's Landing, Atlantic County, April 23rd, 1905. T. D. Keim and H. W. Fowler.

Dr. Abbott says they are common about Trenton, and are frequently taken by anglers on lines though are of no value. I found an example in a cut-off of Mantua Creek, near Mantua, in April of 1906. Its carapace was covered entirely with moss-like vegetation. This species is said to occur about Dennisville, in Cape May County, though I have never seen any examples from there.

Terrapene Merrem, Tent. Syst. Amphib., 1820, p. 27, type *Terrapene boscii* Merrem (= *Testudo odorata* Latreille) by first species has priority over *Aromochelys* Gray, Proc. Zool. Soc. Lond., 1855, p. 199, type *Testudo odorata* Latreille by first species. *Aromochelys* now generally in use must then give way to *Terrapene*.

Cistuda odorata Say, Journ. Acad. Nat. Sci. Phila., IV, pt. 2, 1825, p. 206 (ref. infers).

Cistudo odorata Say, l. c., p. 216 (ref. infers).

Emys odorata Harlan, Journ. Acad. Nat. Sci. Phila., VI, pt. 1, 1829, p. 30 (ref. infers).—Harlan, Med Phys. Res., 1835, p. 156 (copied).

Sternothaerus odoratus Holbrook, N. Am. Herp., III, 1838, p. 29, Pl. 4 (ref. infers).—Holbrook, l. c., Ed. 2, I, 1842, p. 133, Pl. 22.

Osothea odorata Abbott, Geol N. J., 1868, p. 799.

Aromochelys odorata Abbott, Nat. Rambles, 1885, p. 475.—Stone, Am. Nat., XL, 1906, p. 169.—Fowler, Am. Nat., XL, 1906, p. 596.

Family EMYDIDÆ.**The Pond Turtles.**

Carapace ovate, broadest behind, margin with tendency to flare outward, highest near middle and usually not strongly convex. Plastron covering whole under surface, with 12 plates, sometimes anterior lobe, though rarely posterior, movable on a transverse hinge enabling animal to completely close its shell. Shell covered with epidermal shields. Neck completely retractile within shell, and bending by a sigmoid curve in a vertical plane. Parietals prolonged downwards, forming suture with pterygoids, or separated from latter by interposition of epipterygoid. Pterygoids narrow in middle, in contact on median line. No parieto-squamosal arch, squamosal widely separated from parietal. Mandible with articular concavities. Outer border of tympanic cavity deeply notched. Lateral temporal arch usually present. Nuchal plate without well developed costiform processes. Dorsal vertebræ and ribs immovably united and expanded into bony plates forming a carapace. A complete set of marginal bones, connected with ribs. Cervical vertebræ without or with mere indications of transverse processes, and centrum of last cervical articulating with that of first dorsal. Caudal vertebræ procœlous. Pelvis not ankylosed to carapace and plastron. Symphyseal branches of pubis and ischium parallel, in contact, or narrowly separated from each other. Plastral bones 9. Epiplastra in contact with hyoplastra. Entoplastron if present oval, rhomboidal, or T-shaped. Digits short or moderately elongate, with not more than 3 phalanges, and latter with condyles. Toes broadly webbed in some, and scarcely webbed in others. Claws 4 or 5.

A large and widely distributed family. Found about ponds, shores of still streams and marshes, and a few strictly terrestrial. Though they take animal food they rarely capture active prey. Most will not bite except under provocation.

Key to the genera.

- a. Plastron not hinged, immovably joined to carapace.
 - b. Alveolar surface of jaws broad.
 - c. Carapace more or less keeled, scarcely depressed; upper jaw not notched in front; alveolar surface of jaws smooth, a deep groove in front; head covered with soft skin.
 - d. Lower jaw with a spoon-shaped dilatation at tip. **GRAPTEMYS**
 - dd. Lower jaw without spoon-shaped dilatation. **MALACLEMYS**
 - cc. Carapace scarcely keeled; upper jaw notched in front; alveolar surface of upper jaw divided by a longitudinal ridge parallel to margin; head with hard skin. **PSEUDEMYS**
- bb. Alveolar surface of jaws narrow.
 - e. Carapace depressed, never keeled; toes strong, broadly webbed, and hind feet largest. **CHRYSEMYS**
 - ee. Carapace considerably arched; feet subequal and toes narrowly webbed. **CLEMMYS**
- aa. Plastron with movable transverse hinge across middle; a movable cartilaginous lateral suture unites carapace with plastron.
 - f. Body depressed; plastron emarginate behind; toes well webbed. **EMYDOIDEA**
 - ff. Body short and high; plastron rounded or truncate behind; toes scarcely webbed. **DIDICLA**

Genus **GRAPTEMYS** Agassiz.

The Map Turtles.

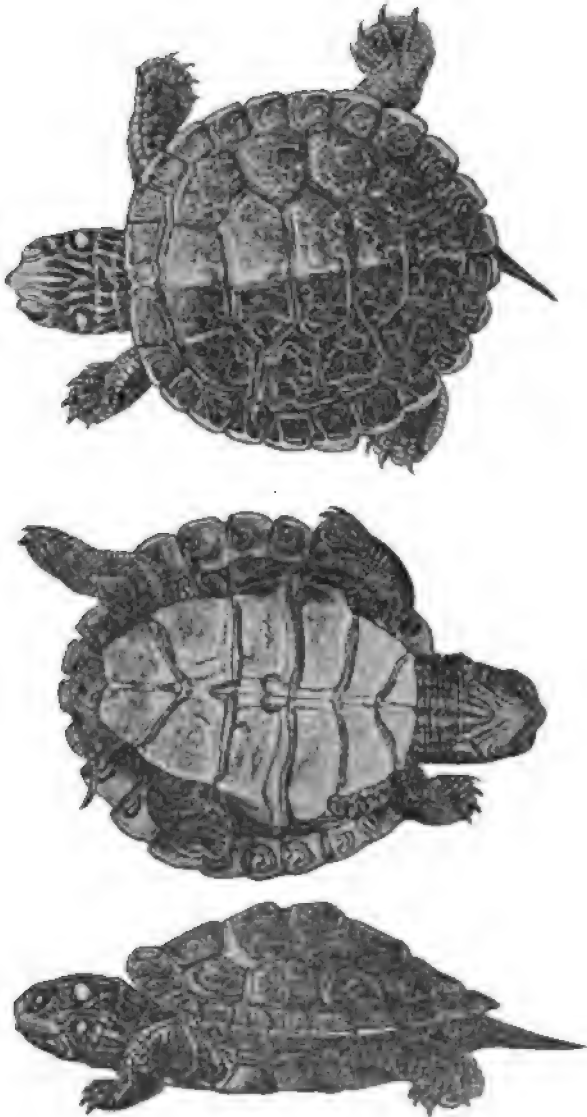
Graptemys geographicus (Le Sueur).

PLATE 61.

Map Turtle.

Carapace broad, depressed, and greatest width about $\frac{4}{7}$ in its length or opposite posterior summit of third vertebral plate. Anterior margin of carapace slightly emarginate. When viewed laterally with greatest depth apparently opposite summit of second vertebral plate (damaged). Median vertebral keel evident, most distinct on last 2 vertebral plates. Marginal plates broad at anterior part of carapace, narrow at sides and deeply concave on upper surfaces of fourth to sixth, third and

seventh but slightly so where adjoining. Posterior marginals broadly expanded and their edges producing serrated appearance



Map Turtle. *Graptemys geographicus* (Le Sueur). (Young.)

with tips of each somewhat rounded. Marginals at bridge all longer than deep and their upper edges forming a lateral ridge to

carapace above marginal concavity. Inguinal and axillary plates large. Plates of carapace all more or less smooth. Plastron elongate, of more or less even width, rounded convexly in front, and rather elongately convex behind. Anterior margin slightly emarginate medianly and posterior margin broadly emarginate, with slight notch on each edge at femoral and anal sutures. Plates on plastron with rather obsolete longitudinal wide-set striæ. Color of carapace when dried dull brownish, with dull brownish reticulating lines of various pattern all over. Inferior portions of marginal shields pale brownish like unicolor plastron, only with a number of transverse brownish lines more or less convergent around each suture from edge of shell. Sutures of plastron dusky. Length of carapace 6 inches. Bay-side. Witmer Stone.

The above described shell is the only information I have concerning this species.

Graptemys geographica Abbott, Geol. N. J., 1868, p. 800.—Stone, Am. Nat., XL, 1906, p. 169.

Genus MALACLEMYS Gray.

The Salt Marsh Turtles.

Malaclemys centrata concentrica (Shaw).

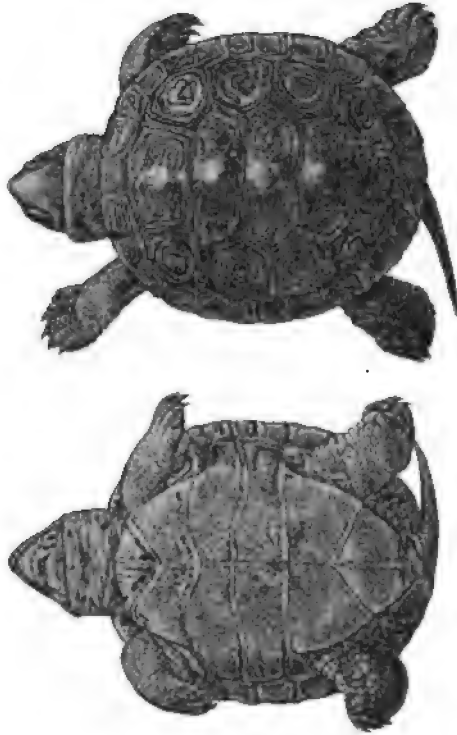
[PLATE 62. *Malaclemys centrata* (Latreille).]

Diamond Back Terrapin. Terrapin. Diamond Back. Salt Marsh Turtle. Salt Marsh Terrapin.

Shell smooth or with concentric grooves. Greenish or dark olive, rarely black. Plates of carapace and plastron usually with concentric dark stripes.

I have no fresh examples. Mr. Stone records it from Cape May (Dr. W. S. W. Ruschenberger), based on 2 shells, and another from Delaware Bay, though without definite locality. One was taken at Anglesea by Mr. Wm. J. Fox in 1896 on the salt-marsh. Mr. George Z. Hartman, of Palermo, Cape May

County, reports it rare on the salt-marshes near there. Mr. H. Walker Hand says it occurs on the salt-marshes about Cape May, though does not seem to be especially abundant. About Stone Harbor, in Cape May County, as many as a dozen are reported to be taken most every year, though they are scarce and rather difficult to procure. They crawl out of the creeks on the advent of frost, and seek winter-quarters by hibernating in the black



Diamond Back Terrapin. *Malaclemys centrata* (Latreille). (Young.)

mud along the banks. This is generally a short distance from the water's edge. They bury a foot or so in the mud and remain there all winter. When spring approaches they become revived, and move out again. They seem to prefer certain places, burying themselves, and will continue for quite a distance up a stream or inlet, till a favored locality is found. By means of the disturbance they have caused in the mud, at the places where they

have attempted to burrow, they may be successfully trailed. They are eagerly sought on account of the high market prices. Animals from the same places are found to vary in color from rather deep slaty to very pale, and others to olivaceous or lighter. In size, those 6 inches in length measured over the plastron longitudinally are usual, and they are said to rarely attain 8 inches. As it is so highly prized as food persistent persecution seems to have more or less caused its decrease in most places. The appended figures of the carolina diamond back show most of the general characters of our form. The differences can best be seen only upon comparison of many individuals. Gray originally spelled the generic name as above.

Emys centrata Say, Journ. Acad. Nat. Sci. Phila., IV, pt. 2, 1825, pp. 205, 211 (ref. iners).—Harlan, Journ. Acad. Nat. Sci. Phila., VI, pt. 1, 1829, p. 27 (ref. iners).—Harlan, Med. Phys. Res., 1835, p. 153 (copied).

Malaclemmys centrata Stone, Am. Nat., XL, 1906, p. 169.

Emys terrapin Holbrook, N. Am. Herp., II, 1838, p. 13, Pl. 2 (ref. iners).—Holbrook, l. c., Ed. 2, I, 1842, p. 87, Pl. 12.

Malacoclemmys palustris Agassiz, Contrib. Nat. Hist. U. S., I, 1857, p. 437.

Malacoclemmys palustris Abbott, Geol. N. J., 1868, p. 800.

Malaclemmys palustris E. Smith, Proc. Linn. Soc. N. Y., 1898-99, No. 11, p. 17.

Genus PSEUDEMYIS Gray.

The Red Bellied Turtles.

Pseudemys rubriventris (Le Conte).

PLATE 63.

Red Bellied Terrapin. Red Bellied Turtle. Slider. Skill Pot.
Potter.

Carapace broad, ovoid as viewed above, with greatest width about last third in its length or about opposite front of fourth vertebral plate. Anterior margin of carapace barely indented. Carapace when viewed laterally with greatest depth about oppo-

site suture between second and third vertebral plates, and posterior and anterior descent of profile more or less similarly and evenly convex. No median vertebral keel. Posterior surface of carapace sloping down more gradually than anterior and marginal plates all more or less expanding out, those at bridge most steep. Edge of carapace as seen in profile forming but a slight angle at junction of ninth and tenth marginal plates, and from over bridge it slopes evenly up anteriorly. Two median plates forming bridge deeper than long, and their uppermost edges forming a well-marked lateral ridge to carapace, which also extends a short distance further both in front and behind. Inguinal and axillary plates large and rather broad. Plates of carapace smooth, striæ obsolete, and with a slightly corrugated appearance. Plastron elongately ovoid, without marked constriction, and its greatest width falling about last fourth in its length or opposite middle of femoral plates. Front of plastron truncate, and then a slight emargination at junction of each thoracic with humeral plates in convergence towards bridge. A notch at junction of femoral and anal plates, also median junction posteriorly of pair of latter. Plates on plastron with obsolete angular striæ. Head comparatively small, slender or fusiform, depressed both above and below, and with somewhat swollen appearance posteriorly. Upper surface more or less level. Snout obtusely protruding beyond mandible, nearly as long as broad, short, and in profile sloping convexly down inferiorly towards mandible. Eye moderately large, socket a little over 3 in head, much larger than snout, lateral and circular. Mouth inferior, edge of upper jaw closing over lower, emarginate anteriorly as viewed laterally, and when viewed in front also with a distinct notch. Edges of jaws flattened or levelled inferiorly, especially in front. Mandible when viewed from below rather broadly convex, so that its length is about $\frac{3}{5}$ its width. When viewed above profile of head forms a rather even triangle. Head and neck at least distensible for space equal to third of carapace, and skin rather finely wrinkled on neck where it forms a fold over retracted head. Legs, feet and tail covered with well-developed scales, those on front of fore limbs, and region of hal-

lux of hind ones largest. Scales on palms and soles all small. Scales not especially enlarged at bases of fingers and toes above. Tail well scaled above. Limbs moderate, strong, and hind pair a little larger. Claws 5 on each front pair of limbs, and 4 on each hind pair. Those on fore limbs with median long and slender, graduated down from third, which is longest. Hind claws much shorter, though slender. Tail rather short, robust, conic, and ending in a slender tip. Color when fresh in alcohol with carapace deep blackish-brown, with very obscure slightly paler brown shades. Lateral plates below, and bridge, dull to somewhat pale dusky mottled with dusky-crimson to lighter shades, and deeper shades of crimson and dilute yellowish. Plastron more or less dilute brownish around margin, and both anteriorly and behind mottled with more or less crimson to slightly yellowish and dusky tints. Median portion of carapace more or less pale. Head, legs, feet and tail black, with streaks of yellowish-white on under surface of head, tail and hind limbs. Iris greenish with dusky. Claws blackish. Length about 11 inches. Described from an example taken near Dennisville in Cape May County.

About Dennisville this is abundant in the fresh-water ponds or marshes, and is valued as food. T. D. Keim, H. W. Hand and myself observed it there in September of 1906, when the above described example was taken. A much smaller example differed in having the plastron and lower edge of the carapace more deeply or brightly marked than the one described, besides appearing with more blackish sprinkled about. They are rather shy as a rule when handled, and retract entirely within the shell. The only noise I have heard them make has been a slight hiss, and this only when disturbed or frightened. About Trenton, according to Dr. Abbott, it is abundant, and next to the snapper, the largest species. It reaches a length of 18 inches, though is usually smaller, about 13 inches being most frequent. In this locality they occur in mill-ponds and creeks, though may also occur in the river. They are used as food. They were reported from Mantua Creek, near Mantua, in April of 1906, and Mr. G. Z. Hartman says they occur in fresh-water near Palermo. Near Medford, on one occasion I saw a large example in the Rancocas

Creek. They have also been observed in this locality by Messrs. Witmer Stone and David McCadden.

Emys rubriventris Harlan, Med. Phys. Res., 1835, p. 154.—Holbrook, N. Am. Herp., II, 1838, p. 38, Pl. 6.—Holbrook, l. c., Ed. 2, I, 1842, p. 25, Pl. 6.

Pseudemys rubriventris Stone, Am Nat., XL, 1906, p. 169.

Ptychemys rugosa Agassiz, Contrib. Nat. Hist. U. S., I, 1857, p. 431.

Patychemys rugosa Abbott, Geol. N. J., 1868, p. 799.

Pseudemys rugosa Abbott, Nat. Rambles, 1885, p. 475.

Emys serrata Say, Journ. Acad. Nat. Sci. Phila., IV, pt. 2, 1825, pp. 204, 208 (ref. iners).—Harlan, Journ. Acad. Nat. Sci. Phila., VI, pt. 1, 1829, p. 28.—Harlan, Med. Phys. Res., 1835, p. 154 (ref. iners).

GENUS *CHRYSEMYS* Gray.

The Painted Turtles.

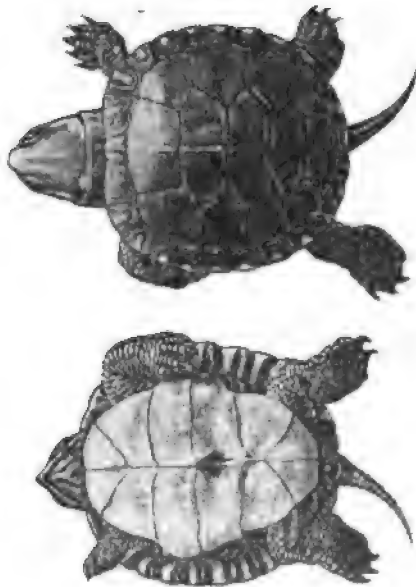
Chrysemys picta (Schneider).

PLATE 64.

Painted Terrapin. Painted Turtle. Yellow Belly. Yellow Bellied Terrapin. Chequered Terrapin.

Carapace rather elongately ovoid as seen from above, and margin entire save for a few slight irregular gashes on anterior median edge and slight median notch posteriorly. Greatest width of carapace about last $\frac{3}{10}$ of its length or opposite front of fourth vertebral plate. When viewed laterally greatest depth of carapace about summit of second vertebral plate, and its margin slopes gradually down to front of eighth marginal plate, then slightly up to tenth and slightly down finally to posterior portion of eleventh. No median vertebral keel, and surface of carapace evenly convex. Anterior surface of carapace a little more steeply convex than posterior, though latter a little more concave at postero-lateral regions than at antero-lateral. Plates forming bridge a trifle longer than broad, and their upper edges

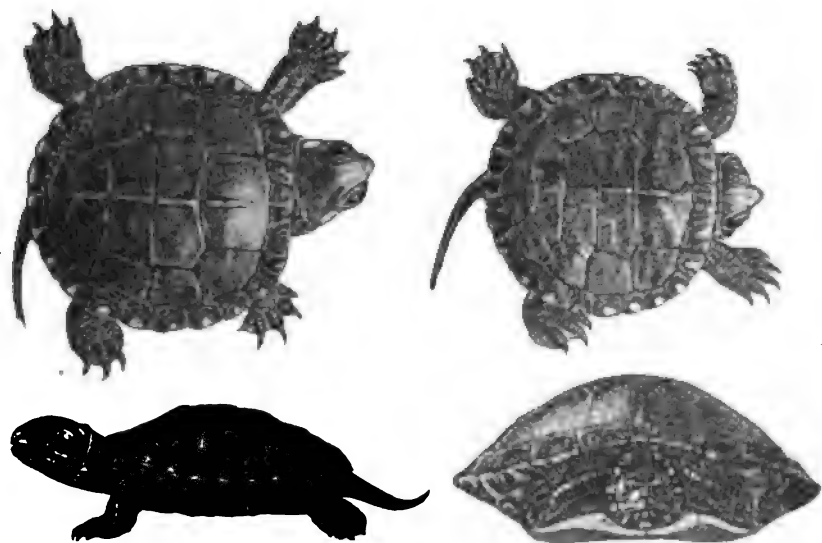
forming an obsolete lateral ridge of rather short extent in front and behind. Inguinal plate long and narrow, and axillary smaller and broad. Plastron large, very elongate-ovoid, or its greatest width but a trifle over half its length, and this point at external margins of femorals. Gulars broad, extending forwards opposite front edge of carapace and with uneven edge. Humeral large. Thoracic and abdominals larger, broad, and latter nearly twice size of former. Femoral larger than humeral, and anal very broadly triangular, much larger than gulars. Plates on both carapace and plastron entirely smooth and without striæ. Head rather short, robust, depressed above and below.



Painted Terrapin. *Chrysemys picta* (Schneider). (Young.)

Snout short, deeper and broader than long, and obtuse. Profile of snout not sloping back very far. Eye large, high and anterior. Mouth curved, and upper jaw shutting outside of lower, with median anterior notch on each side to leave a slight denticle. Mandible slightly recurved upwards in front, and when viewed below broadly triangular so that its length is much less than width. Head and neck distensible for a space about $\frac{1}{3}$ length

of carapace beyond its margin, and wrinkled skin forming a fold over it when retracted. Legs, feet and tail all more or less scaly, and those on anterior faces of former largest. Scales on palms and soles moderate, and those on bases of fingers and toes above large, though not so large as some others. Tail well scaled, 2 rows below. Fore limbs rather short and compressed. Fingers 5, and each with a rather curved slender claw. Hind limbs rounded above, and tarsus flattened. Toes 5, though only each of inner 4 with a long slender claw, longer than those on fingers. Tail short, slender, tapering and rather quadrangular towards



Painted Terrapin. *Chrysemys picta* (Schneider). (Young.)

base. Color in alcohol with carapace blackish-brown. Along or within each of sutures of plates dull olivaceous to brownish streaks, broadest and most pronounced at suture of first and second lateral, and latter and third lateral, and suture of first and second vertebral plates. Middle of carapace with a narrow line of dull brownish, entirely dividing shell. Each of marginal plates with yellowish of below extending over edges in a median marginal blotch soon fading into brownish, which is continued across plate as a transverse line. Usually 1 or more

streaks on each side of this of brownish, very irregular, more or less broken up into bars and spots at times, and also sometimes obsolete or joined by horizontal streaks above. Edges of marginal plates below beautifully variegated, largely with vermilion or bright red to orange and black, lines of demarcation all very distinct. These usually as a broad transverse black ocellus enclosing marginal suture. A black variegated band extends along each side of bridge close below marginal plates at that point. Plastron otherwise uniform yellowish-brown. Head blackish above, with several narrow yellow lines from snout to orbit. Jaws blackish, each with several narrow longitudinal lines. From behind eye 2 yellow lines extend down side of neck, on throat 1 extends from symphysis of mandible, and 1 on each side a little more enlarged than others. Skin on neck and all of limbs generally black. On fore limbs about 3 broken longitudinal red lines and some red dots. Hind limbs with several lemon-yellow streaks, 1 begins at outside of first claw and extends to femoral plate, another extends from hallux and to side of tail, where it is orange and continues out on base of latter a short space. A little posterior a similar shaded line extends along under surface of tail to its tip. On posterior surface of hind limb a lemon-yellow band to base of tail above. On upper surface of tail a little posterior 2 narrow streaks of yellowish extend dorsally to tip. Claws blackish, becoming pale towards tip. Iris slaty. Length about 9 inches. Great Egg Harbor River at Mare Run in Atlantic County. T. D. Keim and H. W. Fowler.

Abundant about Dennisville in the fresh ponds, and valued as food. It attains a little greater size than *Clemmys guttata* with which it usually associates. In fact it seems to be a little more abundant. Mr. Wm. J. Fox found it common on the marshes below Gloucester in 1895. Dr. Abbott says it is common about Trenton, and is used as food, as in most other localities. This was the most abundant species in Cedar Swamp Creek, and the fresh water ponds along the salt-marsh at Palermo, Cape May County. They are shy and usually more difficult to capture than the others. When sitting on a tussock they either

slide off into the water, or should their bodies be inclined much, turn over backwards and then drop in with a splash. They are beautifully marked and of elegant color, always appearing as if freshly painted. If captured, especially the larger ones, they squirm and attempt to get away by clawing. If placed on the carapace they turn over by distending the neck, and struggling with their legs. They are good swimmers and may frequently be seen in the water with only the tip of the nose projecting. Often they crawl out on logs or banks. Though variable in their color-tints to some extent, they are always of the characteristic pattern. Very small ones were equally abundant with the adults.

Emys picta Say, Journ. Acad. Nat. Sci. Phila., IV, pt. 2, 1825, pp. 205, 211 (ref. iners).—Harlan, Journ. Acad. Nat. Sci. Phila., VI, pt. 1, 1825, p. 25 (ref. iners).—Harlan, Med. Phys. Res., 1835, p. 151 (copied).—Holbrook, N. Am. Herp., II, 1838, p. 19, Pl. 3 (ref. iners).—Holbrook, l. c., Ed. 2, I, 1842, p. 75, Pl. 10.

Chrysemys picta Agassiz, Contrib. Nat. Hist. U. S., I, 1857, p. 438.—Abbott, Geol. N. J., 1868, p. 800.—Abbott, Nat. Rambles, 1885, p. 475.—Cope, Am. Nat., XXX, 1897, p. 943.—Stone, Am. Nat., XL, 1906, p. 169.

Genus CLEMMYS Ritgen.

The Wood Tortoises.

Key to the species.

- a. Carapace usually more or less keeled; upper jaw deeply notched and arched downward.
 - b. Head not notably narrower below than above; a bright orange blotch on each side of neck. MUHLENBERGII
 - bb. Head decidedly narrower below than above; no orange blotch on each side of neck. INSCULPTA
- aa. Carapace not keeled; edge of upper jaw nearly straight or but slightly notched. GUTTATA

Clemmys muhlenbergii (Schœpff).

PLATE 65.

Muhlenberg's Turtle. Muhlenberg's Terrapin. Mud Turtle.

Carapace broadly ovoid, and as viewed above with greatest width about last third of its length, or about opposite suture of third and fourth vertebral plates. Margin of carapace entire save for slight notches at sutures, and in front scarcely indented medianly. When viewed laterally greatest depth of carapace about summit of third vertebral plate, and posterior descent of profile a little more evenly convex than anterior, which slopes down more gradually forwards. Median vertebral keel obsolete. Posterior surface of carapace sloping down a trifle more steeply than anterior, and marginal plates all more or less expanding out, those at bridge as usual most steep. Edge of carapace seen in profile sloping down gradually behind to margin of eighth plate, after which it is very slightly concave, and then a trifle convex. Two median plates forming bridge deeper than long, and their uppermost edges forming a slight ridge which is also continued both in front, and behind some distance. Inguinal and axillary plates rather large, and inconspicuous under edge of carapace. Plates of carapace all with concentric angulated striæ. Plastron elongately ovoid, its greatest width about $1\frac{4}{7}$ in its length and falling about last fourth or opposite femoral plates. Both anterior and posterior edges of plastron with a median broad emargination. Edges of plastron scarcely notched at sutures of plates. Gular plates rather large, and both together form a triangle. Humeral plates a little smaller than thoracic, which are nearly as large as abdominals. Femoral and anal very broad and large. Plates on plastron with pronounced striæ. Head and neck rather small and short, former rather elongate, depressed, and with broad upper surface rather evenly convex. Posteriorly head but little swollen. Snout short, obtuse, front surface bevelled inferiorly, and when viewed above seen to be twice as long as broad. Eye large, rather high, and comprising last $\frac{3}{4}$ in space between tip of snout and rictus.

Mouth rather large, inferior, edge of upper jaw closing over lower, and when viewed in front with a distinct notch. Surfaces of jaws a little convex. Mandible slightly turned up at symphysis, and when viewed from below its length about $\frac{4}{5}$ of its width. Head and neck distensible for space beyond carapace about $\frac{3}{5}$ length of latter. On neck skin rather finely wrinkled with minute scales, and forming a fold over retracted head. Legs, feet and tail covered with well-developed scales, those on front of fore limbs large. Large scales also on front of femur and posterior tibial region. Scales on palms and soles all small. At bases of fingers and toes above scales especially enlarged. Tail well scaled, in 2 series below. Limbs moderately strong, anterior a little larger, and with 5 well-developed slender curved claws. Hind limbs with but 4 claws on inner toes, outer obsolete. Tail elongately conic and tapering to a slender tip. Color in alcohol dark brownish to dusky on carapace, or with more or less blackish tints. Each plate of plastron black with narrow dull chestnut margins, and median suture with a broad yellowish-brown longitudinal streak which also bifurcates more or less and passes somewhat narrowly on most all transverse sutures. Under surface of marginal plates of carapace blackish with brownish sutures. Head blackish above. A short indistinct yellow line extends from snout to eye. Jaws brownish. Top of head with several yellow spots and a bright large orange blotch on each side of head posteriorly above. Neck dark brown above, paler below, and below brownish with dusky mottlings. Feet dusky or blackish above, brownish below marked with pale dusky. Tail blackish. Iris brownish. Length about $4\frac{1}{4}$ inches. Medford, Burlington County. May 20th, 1905. Witmer Stone.

Color of the above in life with carapace livid blackish, and darker or paler mottlings very obscure or diffuse. Plastron opaque blackish except narrow median streak which is pinkish, though laminæ on thorax become more or less ruddy or pinkish tinted. Head and feet blackish with more or less dusky-crimson below. A dark crimson-tinted streak extends down dorsal region of tail. Upper surface of head with deep drab lines, one immediately supraocular and along side of snout above.

Lower surface of head and legs with each scale marked with more of a dull crimson spot. A large bright orange bean-shaped blotch on each mastoid region, extending back a little in this example on skin of neck. Lower surface of head about mandible with a number of brick-colored obscure specks. Jaws horny-colored. Skin of shoulders rather bright brick-pink. Skin of groin a little more or less reddish. Feet dirty brown with more or less reddish tints. Claws horny-black. Iris deep amber.

An example taken in a fresh-water pool at the edge of the tide-marsh at Palermo, April 15th, 1906. Color of upper surface of carapace burnt-dusky or blackish. This tint extends over most of the body. Lower surface, plastron, and edges of lateral scales of carapace with more or less horny-reddish or warm brown tints. Legs, tail and head dusky with warm orange-brown markings. Top of head spotted with bright yellow. Several orange spots on side of head posteriorly, one quite large.

Mr. B. W. Griffiths and myself secured a fine example in a ditch near Grenloch in Gloucester County on May 19th, 1907. It was found in a meadow-ditch of clear water. In color it was rather brownish with rather conspicuous markings on the carapace. The large blotch of orange-red on the upper side of the neck in front was very distinct. It was of the usual size.

This turtle is mentioned from Cloister by Mr. C. H. Townsend in Bull. N. Y. Zool. Soc. for July, 1906, p. 289. Dr. Abbott has found it rather abundant and colonial in the meadow ditches near Trenton. It was also aquatic in habits and similar to *C. guttata*.

The first account of this species is *Testudo mühlenbergii* Schœpff, Hist. Testud., 1792, p. 132, based on examples collected by Muhlenberg in Pennsylvania.

Emys mühlenbergii Harlan, Journ. Acad. Nat. Sci. Phila., VI, pt. 1, 1829, p. 25 (ref. infers ?).

Emys mühlenbergii Harlan, Med. Phys. Res., 1835, p. 152 (copied).—Holbrook, N. Am. Herp., I, 1835, p. 59, Pl. 5.—Holbrook, l. c., Ed. 2, I, 1842, p. 45, Pl. 4.

Clemmys muhlenbergii Agassiz, Contrib. Nat. Hist. U. S., I, 1857, p. 443.

Clemmys muhlenbergii Abbott, Geol. N. J., 1868, p. 800.

Clemmys muhlenbergii Abbott, Am. Nat., XVI, 1882, p. 707.

Chelopus muhlenbergii Abbott, Nat. Rambles, 1885, p. 475.

Chelopus muhlenbergi E. Smith, Proc. Linn. Soc. N. Y., 1898-99, No. 11, p. 19.

Clemmys muhlenbergi Stone, Am. Nat., XL, 1906, p. 169.—Fowler, Am. Nat., XL, 1906, p. 596.

Emys biguttata Say, Journ. Acad. Nat. Sci. Phila., IV, pt. 2, 1825, pp. 205, 212 (ref. infers?).

Clemmys insculpta (LeConte).

PLATE 66.

Wood Tortoise. Red Belly. Rough Backed Turtle. Rough Back. Fresh Water Terrapin.

Shell carinated and its plates marked with concentric striæ and radiating black lines. Color reddish-brown and each plate of plastron with a black blotch.

This is an upland species and is scarce. It reaches a length of 8 inches and is in demand as food. Dr. Abbott says it is rare about Trenton. There is a shell in the Academy from Woodbury. It sometimes lives in the dry woods though most of those I have seen were along the banks of streams.

Emys insculpta Harlan, Med. Phys. Res., 1835, p. 152 (copied).—Holbrook, N. Am. Herp., II, 1838, p. 17, Pl. 2.—Holbrook, l. c., Ed. 2, I, 1842, p. 93, Pl. 13.

Glyptemys insculpta Agassiz, Contrib. Nat. Hist. U. S., I, 1857, p. 443.—Abbott, Geol. N. J., 1868, p. 800.

Chelopus insculptus Abbott, Nat. Rambles, 1885, p. 475.

Clemmys insculptus Stone, Am. Nat., XL, 1906, p. 169.

Emys scabra Say, Journ. Acad. Nat. Sci. Phila., IV, pt. 2, 1825, pp. 204, 210.—Harlan, Journ. Acad. Nat. Sci. Phila., IV, pt. 1, 1829, p. 26.

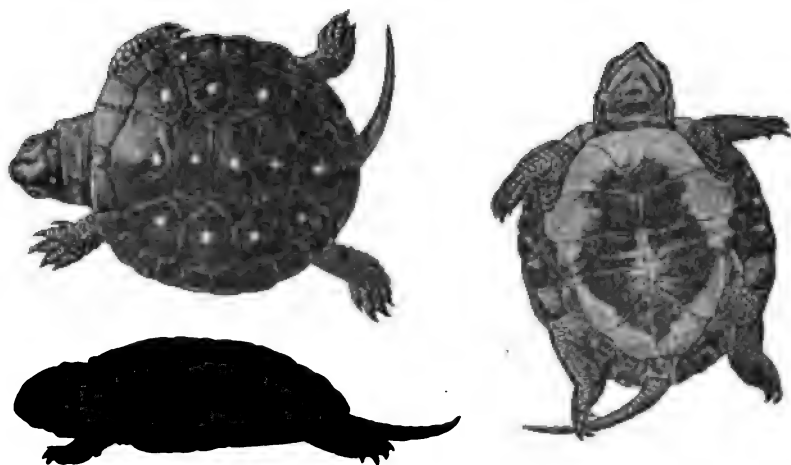
Clemmys guttata (Schneider).

PLATE 67.

Spotted Terrapin. Speckled Tortoise. Speckled Terrapin.
 Spotted Tortoise. Speckled Back. Yellow Spotted
 Terrapin. Pond Turtle.

Carapace broadly ovoid as viewed above, with margin entire, and greatest width about opposite commissure of third and fourth vertebral plates at, or a trifle before, last third in length. When viewed laterally greatest depth of carapace about middle of its length, and its margin sloping gradually down behind. No distinct median vertebral keel, except a median obsolete trace anteriorly. Posterior surface of carapace sloping down a little more abruptly than anterior. Marginal plates all more or less expanding, especially those postero-lateral, and those at bridge most steep. Posterior profile of edge of carapace becoming slightly curved down. Plates forming bridge all a little longer than broad, and their upper edges forming distinct lateral ridge which extends somewhat forwards and backwards. Inguinal and axillary plates rather large and more or less inconspicuous under marginal plates. Plates of carapace smooth and with obsolete striae. Plastron large, elongately ovoid, and greatest width falling about last $\frac{2}{7}$ in its length or opposite middle of femoral plates. Gular plates with a slight median anterior emargination. Humerals smaller than thoracic, and abdominals largest. Femorals larger than thoracic, and anals large, their posterior margins broadly incised. Plates on plastron with distinct angular striae. Head short in comparison, rather small, depressed above and below, and with somewhat swollen appearance posteriorly, upper surface more or less broadly and slightly convex. Snout short, deep, long as deep, though its breadth greater than either, and in profile triangularly convex with lower sloping down posteriorly to mandible. Eye large, high and anterior. Mouth moderate, convex in profile, sloping up posteriorly, and upper jaw shutting over mandible with a median notch anteriorly.

Lower jaw strong and curved up in sharp point at symphysis. Mandible when viewed below broadly triangular with its length $1\frac{1}{3}$ in its width. When viewed above profile of head forms a rather even triangle. Head and neck distensible for a space at least $\frac{2}{5}$ length of carapace, and skin finely granulated and wrinkled on neck where it forms a fold over retracted head. Legs, feet and tail covered with well-developed scales, and those on anterior faces of limbs largest. Scales on palms and soles, excepting hallux, small. Scales at bases of fingers and toes above not especially enlarged. Tail well scaled, in 2 series below. Fore limbs rather short, and hind limbs rounded at thigh, and



Spotted Terrapin. *Clemmys guttata* (Schneider). (Young.)

with flattened tarsi. Fore limbs each with 5 fingers with a single claw, median longest and slender, and of 5 toes of hind limb only 3 inner ones clawed, median pair longest or longer than any of others. Tail slender, conic, rather long and flattened below basally. Color in alcohol scarcely faded from that of example noted below. Carapace black marked with a number of orange spots, none larger than pupil and not more than 2 or 3 on each plate. Head and neck blackish above, with a few spots of yellowish-white. Upper jaw horny-brown, lower more whitish. A large yellowish-white blotch above and behind tympanum. Limbs blackish above and brownish below all more

or less with white interspersed dots, specks, reticulations or streaks of one or other colors. Tail largely blackish below. Plastron horny terra-cotta, also marginal plates of carapace below. Sutures at bridge and edges of marginal plates of carapace black. A broad median area of blackish down each series of plates on carapace. Claws blackish. Eye brownish. Length about $6\frac{1}{4}$ inches. Mare Run, tributary of the Great Egg Harbor River above May's Landing in Atlantic County. April 23d, 1905. T. D. Keim and H. W. Fowler.

Near Cold Spring in Cape May County, Mr. H. W. Hand and myself found this turtle very abundant in April of 1904. They were found in the fresh water-soaked marshes and pools at the edge of the salt-marshes. None were seen in the latter, however. They seemed to prefer the short grass. A beautiful example had the carapace black in life, spotted with bright orange-yellow. Head and legs marked with rose-red and black. Claws black. Jaws reddish and sides marked with longitudinal brick-red lines. Iris brown with a longitudinal dark band. Top of head with several dark spots. Plastron pale brownish marked with black. Length 6 inches.

Abundant about Dennisville in Cape May County, and sought for as food. They do not attain quite the large size of *Chrysemys picta* though are equally active and vigorous. Dr. Abbott says it is abundant about Trenton and is used as food. Mr. S. Harbert Hamilton found it in Mantua Creek, near Mantua, in April of 1906. Mr. Witmer Stone reports it about 3 miles southeast of Woodmansie in Burlington County. About Palermo, Cape May County, George Z. Hartman, T. D. Keim and myself found it abundant in pools about the edge of the salt-marsh. It was, however, less abundant than *Chrysemys picta* and *Kinosternon pensylvanicum*. This was in April of 1906. We also found the young.

Emys guttata Say, Journ. Acad. Nat. Sci. Phila., IV, pt. 2, 1825, p. 212 (ref. iners).—Holbrook, N. Am. Herp., II, 1838, p. 25, Pl. 4 (ref. iners).—Holbrook, l. c., Ed. 2, I, 1842, p. 81, Pl. 11.

Nanemys guttata Agassiz, Contrib. Nat. Hist. U. S., I, 1857, p. 442.—Abbott, Geol. N. J., 1868, p. 800.—Abbott, Nat. Rambles, 1885, p. 475.

Clemmys guttatus Stone, Am. Nat., XL, 1906, p. 170.

Emys punctata Harlan, Journ. Acad. Nat. Sci. Phila., VI, pt. 1, 1829, p. 25 (ref. infers).—Harlan, Med. Phys. Res., 1835, p. 151 (copied).

Genus EMYDOIDEA Gray.

The Blanding Turtles.

Emydoidea blandingi (Holbrook).

PLATE 68.

Blanding's Turtle.

Color black, usually with numerous yellowish spots above. Plastron yellowish with black blotches. Head yellow-spotted. Young nearly circular and black. Reaches 8 inches in length.

This is only known from within our limits by the record of Dr. C. C. Abbott.

Emys meleagris Abbott, Nat. Rambles, 1885, p. 475.

Genus DIDICLA Rafinesque.

The Box Tortoises.

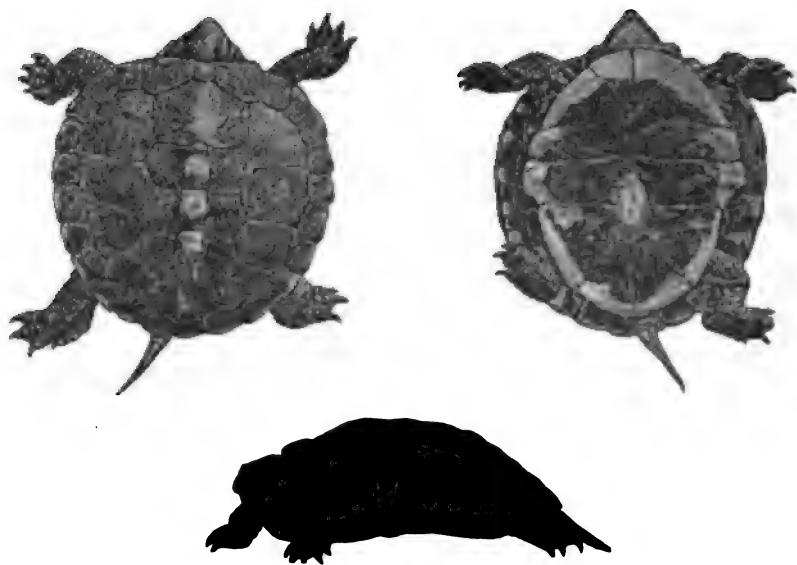
Didicla carolina (Linnæus).

PLATE 69.

Box Tortoise. Tortoise. Common Box Tortoise. Turtle.
Land Turtle. Land Tortoise. Box Turtle. Common
Box Turtle.

Carapace slightly ovoid as viewed above with greatest width about last fourth in its length or opposite front portion of fourth vertebral plate. Anterior margin of carapace a little emargin-

ated. Carapace when viewed laterally deepest at third vertebral plate and posterior descent of profile much more evenly convex than anterior, median keels of each vertebral plate only slightly jutting out. Vertebral keels rather narrow and low, their surfaces smooth. Lower margin of carapace barely sloping down to suture of seventh and eighth marginal plates, then turning outward and backward to slightly descend again behind. Plates forming bridge of plastron, along margin, with anterior much deepest, and others graduated smaller behind. No axillary or inguinal plates. Each plate of carapace with conspicuous concentric rings. Plastron a little ovoid, and its greatest width falls about $\frac{3}{5}$ of its length, or well behind the bridge. Front



Box Tortoise. *Didicla carolina* (Linnæus). (Young.)

of plastron obtuse, each side converging back with somewhat straight edges. Behind bridge sides of plastron more or less undulated convexly all around, without median notch posteriorly. Plates on plastron all with more or less obsolete striated surface. Head rather large, heavy, flattened and depressed above and below, and scarcely swollen laterally behind each eye. Snout truncate in profile, rounded when viewed above, convex on surface, and its length about $\frac{2}{3}$ its width. Eye large, socket about

a third of head to occiput, lateral, and longer than deep. Mouth horizontal, inferior, edge of upper jaw shutting over lower all around so that mandible is inferior. Upper jaw hooked in front. Edges of jaws sharp and horny and when closed gape slightly undulated. Mouth when viewed below more of an equilateral triangle than upper surface of head, which is somewhat of an isocles. Head and neck capable of being protracted half length of carapace, and skin on neck forming fold for protractile head, wrinkled and pustulate, or with small tubercles. Legs and feet covered with large scales anteriorly on former and just behind palm, and on femoral and tarsal region of latter. Scales on calves and bases of toes above also large. Large scales on tail above. Limbs strong, and hind pair broadest. Claws 5 on each front pair of limbs, and 4 on each hind pair, strong, former short, and posterior larger, more curved and powerful. Tail conic, about equal from space between tip of snout and occiput. Color in life carapace jet-black, beautifully variegated and speckled with bright ochre-yellow blotches of various patterns, though some more or less radiating on large shields. These markings also similar on anterior marginal plates. Sutures or articulations of all marginal plates broadly black. Lower surface of marginal plates of plastron pale horny-brown generally and anterior half of this region finely streaked with dusky-brown. These streaks on plastron itself variable, more or less radiated, and on 2 median pairs of plates somewhat broken into specks or irregular spots of small size. Specks or blotches of blackish rather than brown along lower surface of marginal plates, and these latter also with more or less ochre tints. At each junction of plastron laterally with bridge of carapace a dull orange tinge. Head beautiful bright ochre with large black reticulations. Jaws with black transverse streaks though not present below or posteriorly. Neck duller ochre, due largely to slightly dark lines formed in fine squamous reticulations of skin. Blackish vermiculating or reticulating lines of upper surface of head unite on throat posteriorly, though rather obscurely defined and fading out more or less posteriorly. Skin within cavities of shell dull chrome to brownish. Scales on limbs largely dull orange and claws horny-brown, becoming transparent

towards tips. Skin between scales of limbs dirty yellowish-brown. Scales on anterior portions of limbs rather brighter than those behind, which are somewhat brownish or dirty orange. Tail similar, only darker. Eyelids brownish. Iris carmine. Length $5\frac{3}{8}$ inches, measured across carapace. Cold Spring near Cape May, in Cape May County. October 7th, 1906. T. D. Keim and H. W. Fowler.

About Dennisville, in Cape May County, this species was reported to be abundant in dry places, though never more than several are met with during a single tramp. Dr. Abbott tells me of an example which was dated and found 58 years later near Trenton, in which locality the species is common about the uplands, though variable. About Palermo in Cape May County, G. Z. Hartman and T. D. Keim found it close to the edge of the salt-marsh in April of 1906. This example had bright carmine eyes. I have found these animals copulating and the sexes probably remain together some time.

The generic name *Didicla* Rafinesque, Atlant. Journ. Fr. Knowl., 1832, p. 64, type *Testudo clausa* Gmelin (= *Testudo carolina* Linnæus) intended and first species, is the oldest available for the box tortoise. *Cistuda* Fleming, Philos. Zool., II, 1822, p. 270, cannot be used as the only species mentioned is the "box tortoise" though his work is evidently based on Cuvier, Règne Animal, II, 1817, p. 11, where the first species mentioned, and thus consequently its type, is *Testudo subnigra* Daudin. *Cistuda* would then supersede *Sternothærus* Bell, Zool. Journ., II, 1825, p. 305, with its type by first species *Sternothærus trifasciatus* Bell, from China.

Cistuda carolina Holbrook, N. Am. Herp., III, 1835, p. 9, Pl. I (ref. infers).—Holbrook, l. c., Ed. 2, I, 1842, p. 31, Pl. 2.

Cistudo carolina Davis, Am. Nat., XXI, 1887, p. 88.

Terrapene carolina Fowler, Am. Nat., XL, 1906, p. 596.

Cistudo virginea Abbott, Geol. N. J., 1868, p. 800.

Cistudo clausa Say, Journ. Acad. Nat. Sci. Phila., IV, pt. 2, 1825, p. 205 (ref. infers).—Harlan, Journ. Acad. Nat. Sci. Phila., VI, pt. 1, 1829, p. 23 (ref. infers).—Harlan, Med. Phys. Res., 1835, p. 149 (copied).

PART III.

A Supplementary Account of the Fishes of New Jersey.

By HENRY W. FOWLER,

Of the Academy of Natural Sciences of Philadelphia.

A Supplementary Account of the Fishes of New Jersey.

BY HENRY W. FOWLER.

Since "The Fishes of New Jersey" has appeared in the last Annual Report (1905), the writer has been extending his interest in the fish-fauna of the State. Much new material has been examined and observations recorded, all of which are included in this account. Several species have been added to our fauna, and other rare forms have been taken, most of which have been recorded under the caption "Some Unusual New Jersey Fishes" in a recent number of Science.

As all the species included in the fauna to-day have not been figured in my first report, those which are there omitted are now given in this account, with four exceptions (*Dasybatus centroura*, *Tetronarce occidentalis*, *Roccus chrysops* and *Pterophryne gibba*). Several species which have been overlooked have been included. The unfortunate error of commission in the case of referring the leopard shark to *Galeus* is here noted. It should have been referred to *Galeocerdo* Müller and Henle, as *Galeus* is the correct name for the European topes. In presenting the accompanying figures it is but fair to state that they are taken largely from the works of Le Sueur, De Kay, Storer, Valenciennes, Holbrook, Müller and Henle, Agassiz, Girard, Cope, Abbott, Bean, Jordan, Evermann, Marsh, Kendall and others. There are some few originals of my own. Details are given in an appended "explanation of plates."

During the past warm weather Mr. William J. Fox has been located at Sea Isle City, and was able to make more complete collections of the region. He has been very successful in secur-

ing more or less complete series of the pound-net fishes. Many persons, most of whom have already been credited with conducting field excursions in my first account, and also in the first part of the present one, have assisted and contributed for this.

Family CARCHARIIDÆ.

Carcharias littoralis (Mitchill).

PLATE 70.

Sand Shark.

The head of a large example, taken at Sea Isle City during August, was forwarded to me by Mr. Wm. J. Fox. At Cape May, Mr. H. W. Hand informs me that on opening the stomach of a large shark, evidently this species, the remains of several small sharks which were secured a couple of hours before were found, well macerated by the action of digestion. That they were most likely the sharks which had been captured before he does not doubt, as previously their tails were severed from their bodies. All of the remains were in this condition.

Family LAMNIDÆ.

Lamna cornubica (Gmelin).

Mackerel Shark.

Recorded by me from reports of fishermen at Sea Isle City.

Lamna cornubica Fowler, Science, XXIV, 1906, November 9th, p. 596.

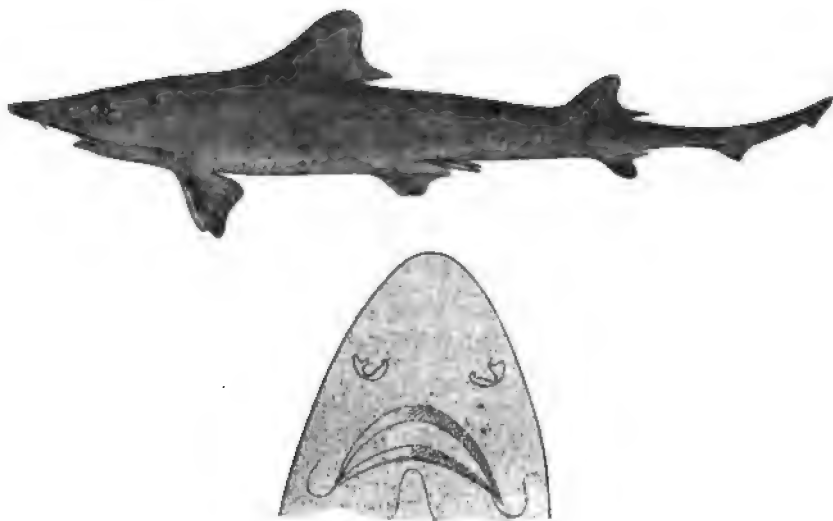
Family GALEIDÆ.

Cynalis canis (Mitchill).

Dog Shark.

Color of an adult when fresh sandy-gray above, inclining to whitish below and on under surface of fins. Tips of dorsals and

caudal slightly dusky. Anal, lower surface of pectorals, and ventrals, whitish like belly. Snout pale, both above and below. Teeth whitish. Iris glassy sandy-gray. Sea Isle City. July 1906. Wm. J. Fox.



Dog Shark. *Cynos canis* (Mitchill).

It was abundant at this locality during all of the past summer. They run with the weak fish about Cape May and appear at the same time.

Genus *GALEOCERDO* Müller and Henle.

The Tiger Sharks.

Galeocerdo tigrinus Müller and Henle.

PLATE 71.

Leopard Shark. Spotted Shark.

This species seems to me to be comparatively rarer than most others. Mr. Wm. J. Fox reports it from Sea Isle City during the past summer. One of about 70 pounds weight was noted by the fishermen August 9th, and another on the 7th of the same

month. By a lapsus I have wrongly referred this shark to *Galeus* Walbaum, the correct name for the topes, in the "Fishes of New Jersey."

Galeocerdo tigrinus Fowler, Science, XXV, 1906, November 9th, p. 596.

***Carcharhinus obscurus* (Le Sueur).**

PLATE 72.

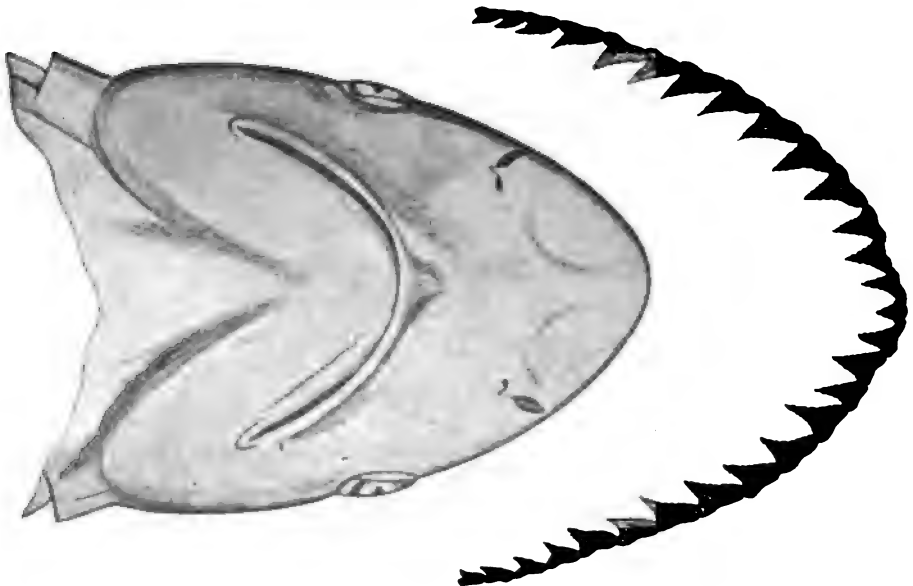
Dusky Shark. Man Eater.

A large shark reported early in July was exhibited at Wildwood. It was about 6 feet long and may possibly have been this species, from all accounts. These large sharks will frequent a favored locality for a long time and it is usually for this reason that the fisherman will try to capture them, as they interfere with the fishing.

***Carcharhinus milberti* (Müller and Henle).**

PLATE 73.

Small White Shark. Shark.



Small White Shark. *Carcharhinus milberti* (Müller and Henle).

Scoliodon terræ-novæ (Richardson).

PLATE 74.

Sharp Nosed Shark.

Family CESTRACIONTIDÆ.

Cestracion tiburo (Linnæus).

PLATE 75.

Bonnet Headed Shark.

Dr. C. C. Abbott says that a stuffed example was in the Academy of Natural Sciences of Philadelphia in 1860 which came from Beesley's Point.

Cestracion zygena (Linnæus).

PLATE 76.

Hammer Head Shark.

One at Sea Isle City, July 23d, 1906, reported by Mr. Fox.

Family RAJIDÆ.

Raja erinacea Mitchill.

Hedge Hog Skate.

Head 3 in body, measured from tip of snout to base of ventrals behind; snout $1\frac{1}{5}$ in head; eye $5\frac{1}{2}$; width of mouth $3\frac{1}{2}$; internasal space $2\frac{5}{8}$; bony interorbital region 4; interspiracle region $2\frac{7}{8}$; space between anterior pair of gill-openings $1\frac{1}{3}$; space between posterior pair of gill-openings 2; space between origins of ventrals $1\frac{2}{3}$; greatest width of ventral, to end of anterior lobe, $1\frac{1}{2}$; base of first dorsal $2^{\frac{8}{7}}$; base of second dorsal 3; length of disk from tip of snout to tips of anterior ventral lobes less than its width by space equal to bony interorbital

area; tail measured from point opposite posterior basal edges of ventrals a little greater than its length. Disk broad. Head well depressed. Snout rather firm, only tip a little flexible, and median fontanel a little depressed. Eye about last $\frac{3}{5}$ of head, elongate, and depressed above. Canthus well depressed. Mouth transverse below, dental edge well convex or slightly double-convex. Teeth about 32 series in upper jaw. Lips thin, upper scarcely free, and only edges of posterior flaps fringed. Nostils large, outside exposed width of mouth, and sending back a groove to corner of mouth and curving posteriorly towards its fellow behind this. Interorbital space broad and concave, though more or less flattened medianly. Gill-openings rather small. Spiracles broad, their width about half of eye. Body rough. An elongate-lunate cluster of large recurved thorns on each anterior edge of disk. On upper surface of tail 4 series of large curved thorns, 2 series on each side though none lateral, and but a few smaller thorns on middle of back. Supraocular and interorbital regions with small thorns. Anterior portions of pectorals above finely roughened, and transversely along outer portion of each an elongated cluster. On each side of back medianly some small thorns. A patch of recurved thorns at posterior basal portion of pectoral. Claspers finely asperous along external edges. Lower surface of body entirely smooth, without prickles. Dorsals 2, at end of tail and of about equal size. Pectoral with anterior edge convex, then concave and finally convex, and entire posterior margin convex. Ventral elongate, anteriorly with a short lobe, otherwise elongate with long compressed claspers. Vent large, well behind origins of ventral fins. Color in alcohol little faded to brownish from that as noted below. Color when fresh broccoli-brown on entire upper surface generally, mostly with small indistinctly defined spots of sepia about size of pupil, or but few larger, and scattered about at more or less regular intervals. Spots not extending on edges of pectoral and ventral fins, or in fact very near margin of disk at any point, which is also more or less paler or translucent. On upper surface of disk also several large or irregular dusky nearly to clove-brown blotches. Sides of snout

pale translucent. Dorsals, caudal, ventrals and claspers above broccoli-brown. Spines all transparent horny-color. Iris silvered with just a trace of brownish with a narrow ring of cream-buff encircling blackish pupil. Lower surface of body livid brownish-white with purplish, bluish and reddish tints, and on outer edges of pectorals some of dark tints as spots showing through transparent fins. Teeth whitish. Lower surface of tail with brownish tints, especially towards its tip. Length $18\frac{1}{2}$ inches. One 16 inches long much paler and dusky blotches absent or replaced by brownish, though spots otherwise more or less uniform. Sea Isle City. April 29th, 1906. Wm. J. Fox.

***Raja ocellata* (Mitchill).**

Big Spotted Skate.

It has been taken off Palermo, in Cape May County, according to Mr. G. Z. Hartman, where it reaches some size. Mr. H. Walker Hand reports it from Cape May, though thinks it is not so abundant along the ocean shore as the other species. When hooked they describe small circles after the fashion of most skates.

***Raja eglanteria* Lacépède.**

PLATE 77.

Common Speckled Skate.

Mr. Geo. Z. Hartman, of Palermo, says it is common. It also occurs at Ocean City. Mr. Fox obtained it at Sea Isle City during the past summer.

***Raja lævis* Mitchill.**

Barn Door Skate.

Mr. Wm. J. Fox reports 5 or 6 large examples nearly 5 feet in length from Sea Isle City, March 18th, 1906. The wings are cut off for food and used by the Italians. One small one, pos-

sibly a young female, with a very spiny tail. They were numerous April 29th, 1906, some reaching a weight of 10 pounds or more, and the "saddles" being preserved by the fishermen. Mr. G. Z. Hartman, of Palermo, reports large examples nearly 5 feet across, evidently this species.

Family NARCACIONTIDÆ.

The Electric Rays.

Trunk broad and thick. Tail comparatively short and thick. A longitudinal fold along each side of tail. Snout not saw-like, blunt and broad. Eyes small. Mouth small. Anterior or nasal valves confluent into a quadrangular lobe. Electric organs present, large, and composed of many hexagonal tubes between pectoral fins and head. Skin perfectly smooth. Usually 2 rayed dorsal fins on tail, first over or behind ventrals. Tail ends in a rayed caudal.

Rays of moderate or large size in most warm seas, and celebrated for their power of giving electric shocks. They are said to pass through first a shark-like, then a ray-like and finally a torpedo-like stage in their development. The very young are furnished with long external gills. A single genus on our shores.

Genus TETRONARCE Gill.

The Torpedoes.

Tetronarce occidentalis (Storer).

Torpedo. Electric Ray. Electric Skate.

Width of disk about $\frac{3}{4}$ its length, very blunt or almost emarginate in front. Spiracles not fringed, their edges smooth. First dorsal more than twice size of second and inserted over middle of ventrals. Color almost uniform black, with obscure darker spots, on upper surface and white beneath. Length 5 feet.

Only known to me from an example captured on a small kingfish line at Long Reach back of Peermont, Cape May County,

July 21st, 1907, by Mr. Wm. J. Fox. This example was moderately large and escaped before it could be landed. This is the first record of its occurrence on our coast.

Family DASYBATIDÆ.

***Urolophus jamalcensis* (Cuvier).**

PLATE 78.

Round Sting Ray.

***Dasybatus centroura* (Mitchill).**

Sting Ray.

Reported from off Palermo, as evidently this species, by Mr. Hartman. Mr. H. W. Hand says that sting-rays, possibly this species, are abundant in Delaware Bay, and about Green Creek, where they are used as fertilizers. They take crab, clam or fish bait and when taken on a line bite like a sea turtle, taking large circles without giving in in the least, when they may be exhausted after a time. They inflict painful wounds, the spines being dirty or slimy also cause much inflammation, and persons have been reported to have been injured for some time. The largest reach about 5 feet. Dr. Abbott says that he saw a sting ray, probably this species, taken from the coast of Belmar off the mouth of Shark River in the late eighties.

***Dasybatus hastata* (DeKay).**

PLATE 79.

Whip Sting Ray.

***Dasybatus say* (Le Sueur).**

PLATE 80.

Say's Sting Ray.

Family MYLIOBATIDÆ.

Myliobatis freminvillii Le Sueur.

PLATE 81.

Stingaree.

Head 3 in body, measured from tip of snout to base of ventrals behind; depth about $4\frac{4}{5}$; snout 2 in head; eye $4\frac{1}{2}$; width of mouth $2\frac{1}{4}$; internasal space 3; bony interorbital region 2; inter-spiracle region $1\frac{3}{7}$; space between anterior pair of gill-openings $1\frac{3}{7}$; space between posterior pair of gill-openings $2\frac{2}{3}$; space between origins of ventrals about $1\frac{2}{5}$; greatest width of ventral $2\frac{1}{8}$; length of ventral $1\frac{2}{3}$; caudal spine to its posterior attachment $1\frac{2}{3}$; base of dorsal fin 4; length of disk from tip of snout to tips of ventrals posteriorly about $1\frac{3}{5}$ in its greatest width; tail, measured from point opposite posterior edges of ventrals, $1\frac{1}{6}$. Disk very broad. Head thick, depressed, broadly convex above. Snout flexible, compressed to lateral trenchant edge ending in a slight fleshy tubercle at top, and as viewed from above broadly convex. Eyes large, elongate, lateral, at some distance in advance of spiracles, with lower canthus well developed, high and about midway in length of head. Mouth transverse below, dental edge slightly undulate or double-concave with depression in middle. Teeth broad as usual, each median lamina very elongate. Lips thick and fleshy, upper broadly free and with rather narrow fringed margin. Lower lip thick, adnate, and with many plicæ. Nostrils large, within width of mouth and sending back a deep groove which curves around each side or corner of mouth though soon lost posteriorly. Interorbital space broad, flattened, or with a rather shallow median depression. Gill-openings rather small. Spiracles large, lateral and deep. Body perfectly smooth. Dorsal fin small, its edges rather evenly convex from origin which falls just behind posterior edges of ventrals, and much longer than high. Tail long and filamentous, cylindrical. Caudal spine longer than space between spiracles, depressed, and each edge antrorsely ser-

rated. Pectorals broadly falcate, their tips falling about last $\frac{3}{7}$ in length of disk. Ventrals rather long, free and truncate, with rounded corners. Vent large, just after origins of ventral fins. Color in alcohol little different from that noted in life or when fresh. Color when fresh, back uniform dusky-brown, only immediate edges of disk paler. Tail all more or less dusky or brownish. A single horn-colored dusky spine. Dorsal pale grayish. Iris slaty-brown, with a brown black-edged ocellus around whitish pupil. Disk below entirely milky-white with soiled effect. Tips and under surface of each pectoral dusky. Length of body with disk 20 inches. July 17th, 1906. Sea Isle City. Mr. Wm. J. Fox. Another taken July 23d at the same place.

Myliobatis freminvillii Fowler, Science, XXIV, 1906, November 9th, p. 596.

Rhinoptera bonasus (Mitchill).

PLATE 82.

Cow Nosed Ray.

Reported by Mr. Hartman from off Palermo.

Family ACIPENSERIDÆ.

***Acipenser sturio* Linnæus.**

Sturgeon.

Mr. Fox reported a few from the pounds at Sea Isle City early in May of 1906. In the Delaware Bay they are fished for as far south as Higby's beach.

Family PSALLISOSTOMATIDÆ.

***Psallisosotomus osseus* (Linnæus).**

PLATE 83.

Gar Pike.

Family ELOPIDÆ.

The Tarpons.

Genus TARPON Jordan and Evermann.

The Tarpons.

Tarpon atlanticus (Valenciennes).

PLATE 84.

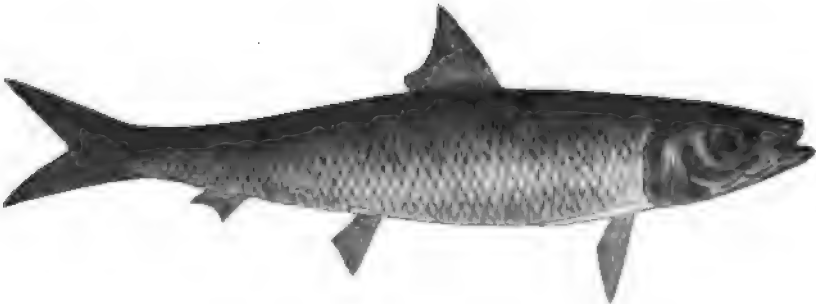
Tarpon. Tarpum.

This is now known from within the limits of the state by the capture of 2 examples near Sandy Hook. The examples were reported in a newspaper by Mr. C. H. Townsend, Director of the New York Aquarium. They lived a short time in captivity.

Family CLUPEIDÆ.

Etrumeus teres (DeKay).

Round Herring.



Round Herring. *Etrumeus teres* (DeKay).

Pomolobus mediocris (Mitchill).

Herring.

Color when fresh, bluish-slaty on back, scales themselves with slight olivaceous tint. On back along each row of scales longitudinally a brownish streak, lowest of which is not much below level with eye. A dusky blotch at shoulder, indistinctly defined,

and with several indistinct traces behind. Head grayish-brown above, this color soiling mandible in front. Body all more or less silvery-white, with beautiful burnished mercury effects. Dorsal and caudal grayish-dusky, basally somewhat tinted dilute olivaceous, and lower margin of lower lobe whitish. Other fins all more or less whitish, margin of pectoral grayish above. Iris silvered. Length $12\frac{1}{4}$ inches. Three examples July 18th, 1906. Sea Isle City. Mr. Wm. J. Fox.

Mr. H. W. Hand says they are taken in the pounds and nets about Cape May.

***Pomolobus pseudoharengus* (Wilson).**

Alewife.

Color in life with back olivaceous-dusky, though only superiorly. Upper surface of head dusky, and this color extending down on mandible, where it shades out below. A dull greenish-dusky shoulder blotch. Scales beautifully washed with mercury-silver, and back overshot with purplish or lilac tints. Scales on back down for about 5 series underlaid with pale lilac longitudinal stripes. Iris silvery, dusky above. Head below eye silvery-white. Inside of gill-opening whitish, speckled with dusky tints. Side of head with brassy reflections. Lower fins translucent brownish, paler basally, and distal portions tinted brownish inclining to a dull dusky. Upper edge of pectoral dusky. Scales on base of caudal silvery. Adult. Cedar Swamp Creek tide-water at Petersburg in Cape May County, April 16th, 1906. T. D. Keim and H. W. Fowler. These fish run in above the dam, and quite a number are taken in gill-nets at times.

Runs in the Tuckahoe River to Tuckahoe.

***Alosa sapidissima* (Wilson).**

Shad.

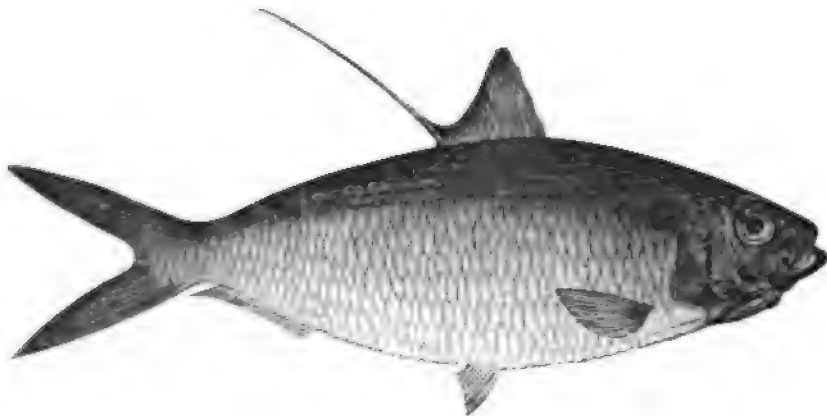
Mr. Fox says a number have been taken in the Sea Isle City pounds early in May of 1906. Mr. Hand says a few are taken in the pounds, during the spring, at Cape May.

Clupanodon oglinum (Le Sueur).

Thread Herring.

Mr. Fox secured 2 examples during the past season.

Clupanodon oglinum Fowler, Science, XXIV, 1906, November 9th, p. 596.



Thread Herring. *Clupanodon oglinum* (Le Sueur).

Brevoortia tyrannus (Latrobe).

Mossbunker.

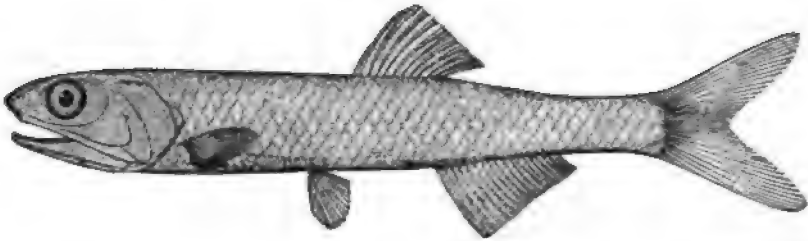
Color when fresh with back generally, till level with eye, glaucous-blue, with slight shades of dusky and metallic tints. Side and lower surface inclining to whitish, and everywhere entire body more or less overshot with bright silvery-white. Upper surface of head brownish-glaucous or olivaceous, with golden, coppery, bronzed, brassy and other metallic tints, also these extending well over sides. Snout and front jaws translucent brownish, and adipose eyelid same. Iris silvery. Branchiostegal region whitish. Inside of gill-opening shaded dark with dusky dots. A broad median dorsal streak shaded olivaceous. Opercle with dusky blotch in front. A blackish shoulder blotch a little

larger than pupil, and well defined. Middle of side, or costal region, with 3 or 4 series of underlaid pale glaucous spots of irregular size, though not any quite so large as pupil. Dorsal and caudal dull olivaceous, edge of lower lobe of latter paler. Pectoral, ventral and anal translucent brownish or whitish. Length 14 inches. Sea Isle City. April 29th, 1906. Wm. J. Fox. About 6 more also reported.

Family ENGRAULIDIDÆ.

***Anchovia eurystole* (Swain and Meek).**

Slender Anchovy.



Slender Anchovy. *Anchovia eurystole* (Swain and Meek).

***Anchovia brownii* (Gmelin).**

PLATE 85.

Broad Banded Anchovy.

***Anchovia mitchilli* (Valenciennes).**

Sperlin.

Mr. Wm. J. Fox reports a single example from Sea Isle City, July 4th, 1906. It was evidently this species and was found among some silversides, *Menidia*, which had been taken for bait.

Anchovia duodecim (Cope).

PLATE 86.

Long Finned Anchovy.

Family ANGUILLIDÆ.

Anguilla chrlaypa Rafinesque.

Eel.

In Mantua creek, near Mantua, small eels were found in abundance up to 6 inches in length. They frequent the creek and all the cut-offs, especially the latter about tide-water, which are more or less choked up with debris. All are more or less of the uniform olive-color above and paler below. They do not appear in special numbers in a locality, but are evenly distributed. When a pile of debris is hauled out on shore they immediately attempt to retreat beneath, by poking about. April 8th, 1906. S. H. Hamilton and H. W. Fowler.

Small ones were found in the streams near Dennisville, in Cape May County, during September of 1906.

Family CYPRINIDÆ.*

Plimephales notatus (Rafinesque).

PLATES 87 (adult) and 88 (young).

Blunt Nosed Minnow.

Semotilus bullaris Rafinesque.

Chub.



Chub. *Semotilus bullaris* Rafinesque. (Half-grown.)

* I find that *Ophiocephalops* recently proposed by me for a sub-genus of *Erythrinidæ* is preoccupied by *Hoploerythrinus* Gill.

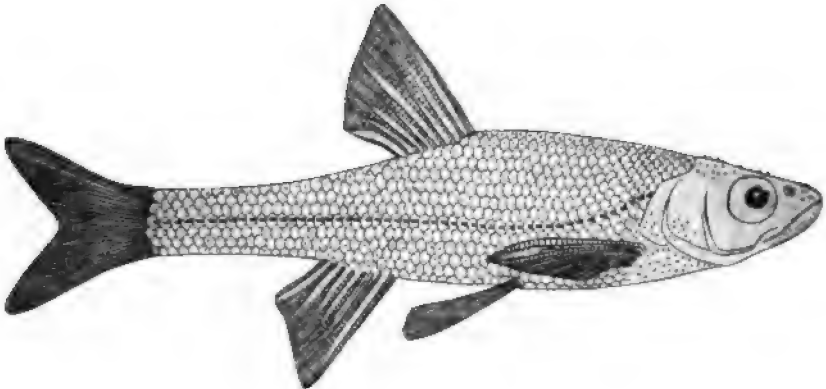
Semotilus atromaculatus (Mitchill).

PLATE 89.

Chub.

Leuciscus vandoisulus Valenciennes.

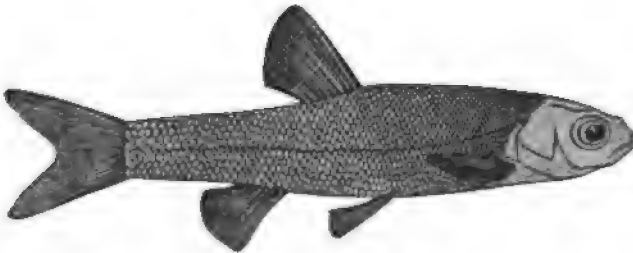
Rosy Dace.



Rosy Dace. *Leuciscus vandoisulus* Valenciennes.

Leuciscus margarita (Cope).

Gold Thread Shiner.



Gold Thread Shiner. *Leuciscus margarita* (Cope).

Brama crysoleucas (Mitchill).

Roach. Roachie. Roache.

Color in life olivaceous-brown on back, with glassy effect. Sides brassy-silvery, becoming white below. Dorsal and caudal diluted warm olive-brown. Pectoral dilute greenish-olive, more or less translucent. Ventral dilute orange-brown in front and on

median portions. Anal transparent medianly, margin with iodide tint. Iris silvered, a little dusky above with purplish and greenish tints. Length 5 inches. Affluent of Crosswicks Creek near Trenton. July 15th, 1906. Many smaller examples were noted as showing same coloration, only altogether more brassy. Examples 4 inches long had the back bluish-green with more or less silvery.

Color in life of young very dark with underlaid blackish lateral band. Also jet-black streak on body at base of anal and extending on lower surface of caudal peduncle. General tint of body deep bottle-blue, or blue-green with a beautiful metallic hue, and in some lights overshot with silvery reflections. Belly and lower surface but slightly paler than back, peritoneum showing through silvery, and in fact most everywhere body has a translucent effect. Fins translucent. Iris silvery, tinted a little dusky above. Small cedar-stained stream from the second pond above Dennisville, in Cape May County, during September of 1906. A number of these small dark examples were seen, their dark coloration suggesting that of *Notropis chalybæus abbotti*. They were difficult to detect and capture in the dark water. Larger ones were reported from the other pond, where they were said to be locally abundant, and are angled for by boys.

Color in life generally with steel-bluish-green, dark tint over lower surface of body, including lower surface of peritoneum, which shows silvery. Iris silvery. Back dark. Scales in lateral line tinted with dusky dots at each tube. Fins translucent brownish. Dorsal and caudal darker than other fins. Edges of pectoral, ventral and anal slightly dusky. Along base of anal a pale dusky streak. Base of caudal with dusky. Along side, after death, a plumbeous lateral streak somewhat evident. Snout and tip of mandible pale dusky. Length a trifle over 2 inches. December 31st, 1906. Petersburg, Cedar Swamp Creek, Cape May County. T. D. Keim and H. W. Fowler. Several examples taken. A smaller example seems to have lateral band a little more evident, also streak along base of anal. These were associated with *Fundulus*.

In the tide-water of Mantua Creek Mr. S. H. Hamilton and myself found these fish very abundant in the deeper pools. One

may angle with dough-bait on a small hook, and secure possibly a dozen large ones in a morning's fishing. They take this bait readily, frequently entirely nibbling it off without being captured, as the cork bobs but little when the line is struck. They are especially brightly colored in early April, with blue backs and red ventrals, and average about 6 inches in length.

Mr. C. H. Townsend calls attention to Dr. Bean's re-examination of specimens of the so-called "pearl roach" in the New York Aquarium. Examples of this fish were described by the latter as *Abramis crysoleucas roseus*. They are evidently an introduced European fish, apparently of another genus. Thus my suggestion that the variety, *Brama crysoleucas versicolor* (DeKay), is the same is unfounded.

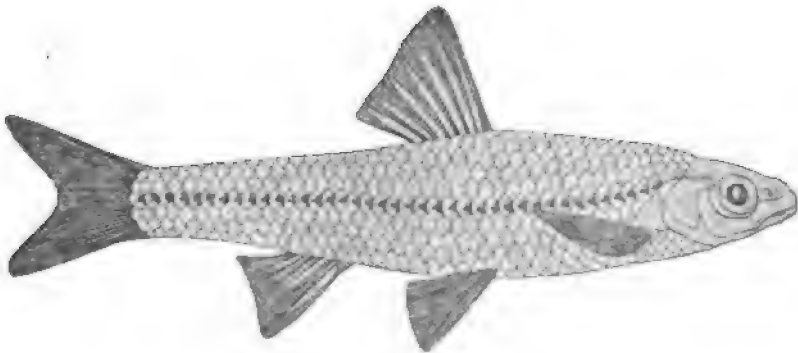
***Notropis bifrenatus* (Cope).**

Bridled Minnow.

Frequent along the sandy shores of Mantua Creek near Mantua. They may be taken in the shallows with a dip-net, associated mostly with other small minnows as *Notropis cornutus* and *Fundulus diaphanus*.

***Notropis hudsonius amarus* (Girard).**

Gudgeon.

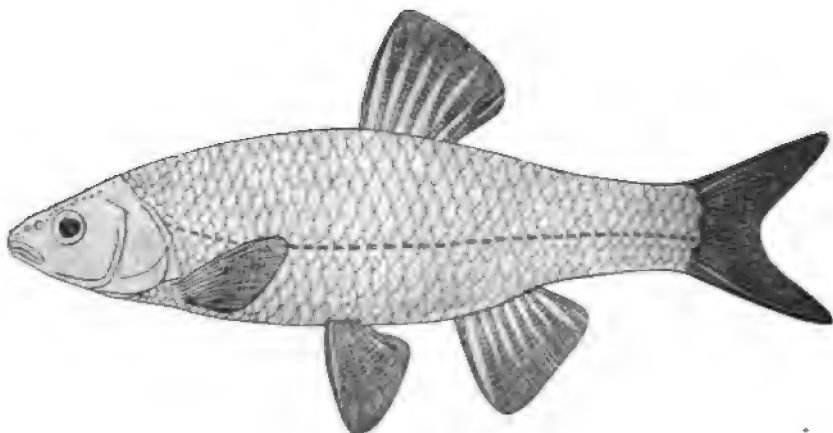


Gudgeon. *Notropis hudsonius amarus* (Girard).

Notropis analostanus (Girard).

Silver Fin.

I found this minnow to be very abundant about sandy riffles in Chestnut Branch of Mantua Creek, April 1st, 1906. Some, quite large, were taken. Also abundant along the sand-bars or shallow banks in Mantua Creek near Mantua with *N. bifrenatus* and *Fundulus diaphanus*. Color in life of young pale translucent brown, side shot with a longitudinal sheen of purple in some lights and in others with blue-green. Fins translucent brownish.

Silver Fin. *Notropis analostanus* (Girard).

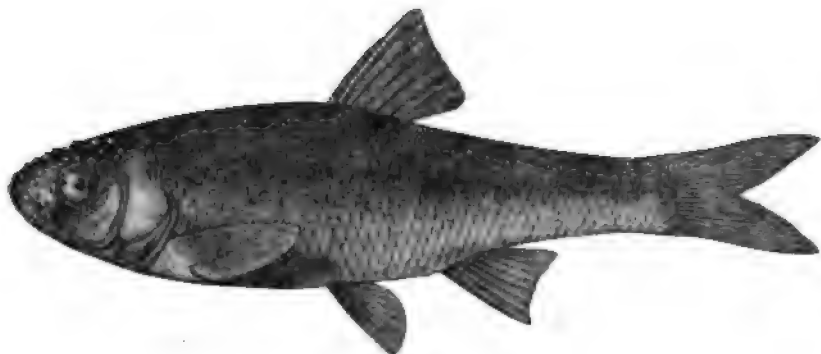
Peritoneum showing through abdominal walls bright silvery. Side of head silvery. Iris silvery-white. A narrow dusky streak from vent to caudal along lower edge of caudal peduncle. Length about $1\frac{1}{2}$ inches. From the summit level of the Delaware and Raritan canal at Trenton, October 10th, 1906. Dr. C. C. Abbott and H. W. Fowler.

Notropis cornutus (Mitchill).

Red Fin.

A large one taken at the second bridge at Mantua, in Mantua Creek, by a dough-bait fisherman. Edge of caudal deep

scarlet, other fins also ruddy. Excrescences on snout and head above. Length about 6 inches. Small ones taken with *N. anolostanus*, *N. bifrenatus* and *Fundulus diaphanus*, about the shallow and often sandy or gravelly banks of the creek. Lateral band dark lead-color and sometimes ending in a dusky spot at base of caudal. This band extends from tip of snout, though not embracing mandible, along side of head and then to caudal. Upper surface pale olive-brown, edge of each scale becoming darker, though those immediately over inlaid lateral band paler so as to form a longitudinal pale streak. Iris silvery, except dusky lateral band across horizontally. Lower surface whitish. Sides and most of lower surface reflected silvery with metallic green, blue or purple sheens in some lights. Fins transparent, lower whitish,



Red Fin. *Notropis cornutus* (Mitchill).

and dorsal slightly brownish, caudal diluted warm brownish. Median dark streak down back. S. H. Hamilton and H. W. Fowler. April 8th, 1906.

***Notropis chalybæus* (Cope).**

Steel Sided Minnow.

Head $3\frac{3}{4}$; depth $4\frac{2}{3}$; D. III, 7; A. III, 7; scales 33 in lateral line to base of caudal; 16 scales before dorsal; 7 scales obliquely back from origin of dorsal to lateral line; snout $3\frac{3}{7}$ in head; eye $2\frac{7}{8}$; maxillary $3\frac{1}{5}$; interorbital space $2\frac{3}{5}$; depressed dorsal 1; anal $1\frac{1}{4}$; pectoral $1\frac{2}{5}$; ventral $1\frac{3}{7}$; least depth of caudal

peduncle 3; caudal $3\frac{3}{7}$ in head and trunk; pharyngeal teeth 2, 4-4, 2. Body robust, compressed and rather long. Lower profile scarcely more convex than upper. Head rather large, robust, compressed, and muzzle somewhat conic. Snout much broader than long, convex. Eye large, circular and a trifle anterior. Mouth rather small and oblique, with jaws nearly even or mandible scarcely protruding. Lips a little fleshy. Maxillary small, barely reaching beyond posterior nostril or to front rim of eye. Gill-rakers few, small and weak. Scales large, and those in front of dorsal somewhat crowded in appearance. Lateral line inconspicuous, with simple tubes, and complete. Origin of dorsal a trifle nearer base of caudal than tip of snout. Anal inserted well behind last dorsal ray in vertical. Caudal rather long and forked, lobes pointed. Pectoral not reaching ventral, or about $\frac{3}{4}$ of space. Ventral placed well before dorsal, and not quite reaching anal. Color in alcohol pale straw-brown, each scale on back above pale area annectant to dark lateral band, edged narrowly with dusky. Lateral band black, with steel blue-green reflections, extends from muzzle including front edge of mandible to base of caudal where it resolves in a jet-black blotch. Along base of anal a narrow streak of dull dusky, and only extending on lower surface of caudal peduncle a very short distance anteriorly. Dorsal and caudal dull straw-brown, pectoral similar only with slight dull dusky margin above, and none of these fins much darker than whitish ventrals and anal. Length $1\frac{13}{16}$ inches. Kinkora Creek near Kinkora, Burlington County. October 15th, 1906. T. D. Keim and H. W. Fowler.

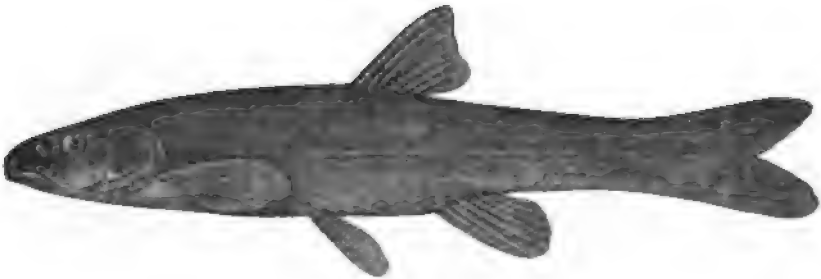
Color in life with back translucent hyaline or greenish-gray, with edges of scales darker and vertebral column showing through translucence distinctly brownish with metallic sheen in some lights. Upper surface of head brownish. From snout, including chin to base of caudal, a black streak or band wide as pupil passes through iris and ends in a distinct black blotch at base of caudal. In its course this band greatest in width at costal region. When in water brownish and coppery reflections of brain and vertebral column appear distinct, latter as a streak just above lateral line or down middle of back. A pale dusky streak

down back from occiput to dorsal. Peritoneum showing through silvery-white. Lower surface of head silvery-white. Iris silvery-white with dark band crossing. Fins transparent grayish, dorsal and caudal scarcely darker, edges of all pale, none dark. Along base of anal a dusky streak more or less fading on lower surface of caudal peduncle. Adult with same data as one described. In young of less than an inch the black caudal spot is very distinct and enlarged.

These little fish were found in a school of possibly 200 or more individuals in the rather gently flowing waters of the above creek. They all herd more or less together and usually are more or less headed in the same direction, with the apparent purpose of holding their own quietly against the current. They sometimes flash their sides in a similar way to the roach. They are not especially shy, the whole school moving more or less by a concerted impulse, and many may be easily scooped out with a dip-net in a single scoop. As they will return again and again after being so disturbed it is an easy matter to secure most of an entire school. I have never yet found this species except as above described, and it usually does not appear to frequent the small colder brooks where *Rhinichthys atronasus* is so abundant. They were associated in the locality where we noted them with a few examples of *Brama crysoleucas*, *Notropis analostanus* and young *Lepomis auritus*.

Rhinichthys cataractæ (Valenciennes).

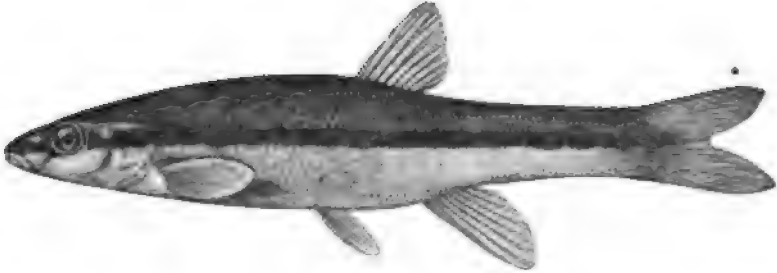
Long Nosed Dace.



Long Nosed Dace. *Rhinichthys cataractæ* (Valenciennes).

Rhinichthys atronasus (Mitchill).

Black Nosed Dace.



Black Nosed Dace. *Rhinichthys atronasus* (Mitchill).

Hybopsis kentuckiensis (Rafinesque).

PLATE 90.

Horny Head.

Family **CATOSTOMATIDÆ**.

Catostomus nigricans (Le Sueur).

PLATE 91.

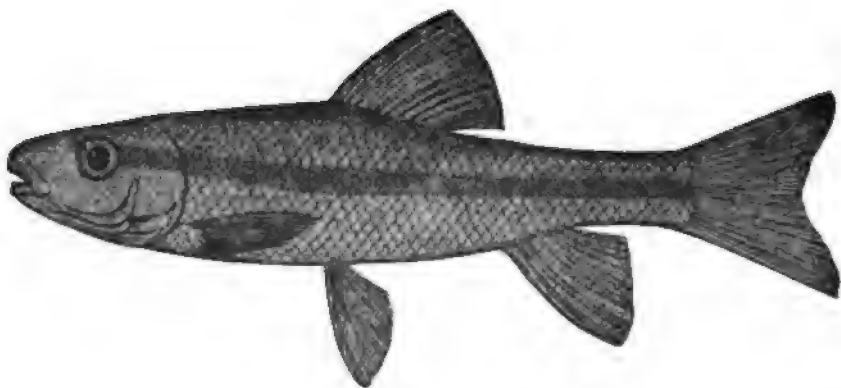
Black Sucker.

Erimyzon sucetta oblongus (Mitchill).

Chub Sucker.

A fine example taken in a small cut-off of Mantua Creek just above Mantua. Color when fresh olivaceous-brown above, deepest on back, and becoming paler or whitish below. Sides and lower surface, especially former, tinted with pale gamboge or light olive, giving somewhat old brassy reflections. Edge of each scale on back and sides olive or a little darker than general coloration. Along middle of side of trunk, from opercle to base

of caudal, an underlaid diffuse broad dusky band marked at intervals with diffuse vertical daubs extending from back above well down below. These about 6 in number, first from predorsal region, second from front of dorsal, third from base of last dorsal rays, fourth just behind dorsal, fifth over anal, and sixth at base of caudal. After death they appear more or less as 6 pairs of diffuse bands. Head olivaceous above, becoming paler or tinted gamboge on sides, and whitish below. Dorsal radii pale brown basally, membranes between dusky-olive till distally, when a broad marginal band of pink-gray is formed, so that margin of fin is only a very trifle more dusky or darker diffusely than this color. Caudal rays largely pale brownish, membranes at base of fin olive-dusky, especially those of lower lobe, then a broad pale



Chub Sucker. *Erimyzon sucetta oblongus* (Mitchill). (Young.)

olive median area more or less overshot with ruddy or pinkish to margin where it is purplish or pinkish-dusky. Pectorals with whitish bases, also few innermost rays, then largely deep brick-ruddy or red, and sprinkled with neutral or dusky distally but so as to leave a slightly submarginal paler area of ruddy to each fin, and this is most conspicuous on its upper or outer surface. Radii of anal, and margin broadly, ruddy-pink, membranes to base dusky. Iris reddish-brown, especially a narrow circle around pupil. Lips whitish. Length $7\frac{3}{4}$ inches. April 8th, 1906. S. H. Hamilton and H. W. Fowler.

Tuberculated males occur in the first pond at Dennisville in Cape May County, and as many as 30 or 40 have been taken during a single day in gill-nets, according to reports.

Family SILURIDÆ.

***Ameiurus natalis prosthistius* (Cope).**

PLATE 92.

Pine Barrens Cat Fish.

Mr. G. Z. Hartman says that a cat fish with white mental barbels occurs in Cedar Swamp Creek, which is very likely this species.

***Ameiurus nebulosus* (Le Sueur).**

Yellow Cat Fish.

Color in life above olivaceous, mostly very bright, fading golden-yellow-olive on sides to whitish on under surface, and in some lights brassy. Lower surface of head tinted coppery. Barbels dusky, mentals slightly pale basally. Fins dusky, caudal, pectoral and ventral paler at bases. Spines brownish. Most of fins with more or less ruddy. Iris brownish-olive with a narrow circle of silver adjoining pupil. Length 12 inches. Cedar Swamp Creek at Petersburg, Cape May County. April 15th, 1906. Many examples in the tide-water all more or less greenish-yellow on sides. They are taken in some numbers in gill-nets. T. D. Keim and H. W. Fowler.

Color of an adult in life deep dusky-olive, vertical fins all dusky. Abdomen creamy. Pectoral and ventral dusky, and barbels blackish. Iris with a narrow circle of silvery. Affluent of Crosswicks Creek near Trenton, July 15th, 1906.

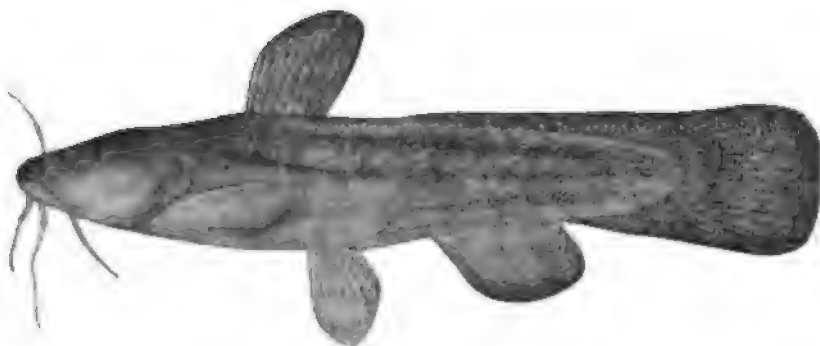
Small examples, most likely this species, were reported from the waters about Dennisville in Cape May County. They are taken at night or in the evening as they rarely take the hook during the day. The usual bait is an ordinary earth worm. Two kinds are said to occur which are styled yellow and white respectively, which however I have not determined.

Schilbeodes gyrinus (Mitchill).

Stone Cat.

Color in life olivaceous-dusky, generally. Dorsal and caudal dark. Belly, ventral, pectoral and lower surface of head tinted saffron-whitish, and more or less whitish in middle of belly. Barbels pale brownish. Iris slaty. Half-grown. Affluent of Crosswicks Creek near Trenton. July 15th, 1906.

Mr. S. H. Hamilton and myself found them very abundant April 8th, 1906, in a small choked up cut-off of Mantua Creek above Mantua, associated with *Anguilla chrisypa* and *Umbra pygmaea*. They swim about rather slowly when in the open



Stone Cat. *Schilbeodes gyrinus* (Mitchill).

water, with rapid contractions of the body. Color in life olive-brown generally, dorsal fin scarcely darker than general color of trunk. Caudal a little more so, its margin rather diffuse pale dusky. Lateral line in a dusky streak. Iris slaty. Pectoral and ventral pale translucent brown, ventral still paler. Abdomen, belly and under surface of head with slight gamboge tints, especially about branchial region, bases of pectorals and ventrals. Barbels brownish, mentals but slightly paler than upper. Largest $3\frac{3}{4}$ inches. Other smaller examples varied somewhat in color, some more or less ruddy-brown tinted, and others which are very small were more or less entirely with blackish. In alcohol they fade out considerably.

Family **ESOCIDÆ**.

Esox americanus (Gmelin).

PLATE 93.

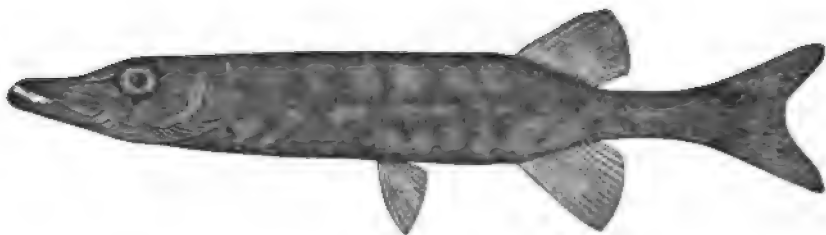
Banded Pickerel.

Examples of nearly 10 inches in length seen in Mantua Creek above Manuta, April 8th, 1906, by Mr. S. H. Hamilton and myself.

Esox reticulatus (Le Sueur).

Chain Pickerel.

Color in life brownish above tinted pale olivaceous and each scale sparkling with coppery. Sides brilliant mossy-green with



Chain Pickerel. *Esox reticulatus* Le Sueur. (Young.)

coppery tints, also in some lights overshot with lilac-bluish and purplish. Sides with dusky reticulations. A broad deep dusky bar from below eye. Upper surface of head speckled brownish. Muzzle brownish speckled with a little deeper brownish above. Iris glassy-coppery with vertical dusky streaks and greenish tints in front and behind. Lower fins pale warm brownish with just a dull tint of orange, paler basally. Edge of gill-opening dull greenish-olive. Length 18 inches apparently. Cedar Swamp Creek at Petersburg, Cape May County. April 16th, 1906. T. D. Keim and H. W. Fowler.

Family UMBRIDÆ.*Umbra pygmaea* (De Kay).**Mud Minnow.**

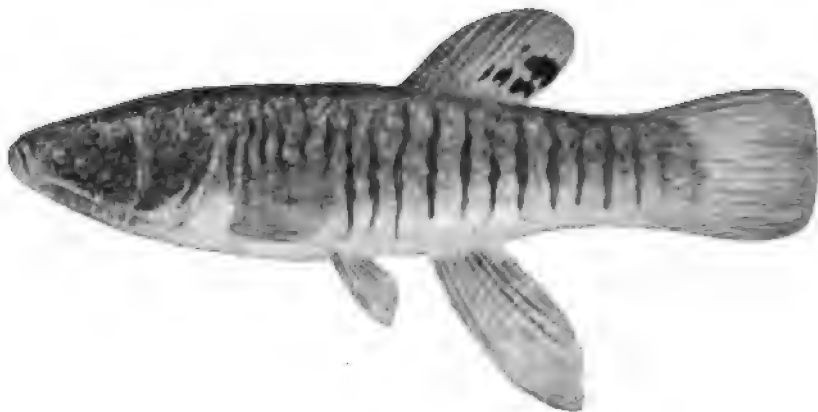
Found in choked up cut-offs of Mantua Creek above Mantua, April 8th, by Mr. S. H. Hamilton and myself. Mostly small in size. One several inches long was very pale olive-brown in color, without trace of dusky markings on back.

Found abundant in the sphagnum of running water of the cut-offs of forks of Cedar Swamp Creek. Some were very pale. December 31st, 1905, and April 16th, 1906. G. Z. Hartman, T. D. Keim, and H. W. Fowler.

Melanura limi Abbott, Pop. Sci. Month., VII, 1875, p. 108.

Family PÆCILIIDÆ.*Fundulus majalis* (Walbaum).**Rock Minnow.**

Abundant about the warm shallows back of Sea Isle City, July 21st, 1906. They were found in rather compact schools of about



Rock Minnow. *Fundulus majalis* (Walbaum). (Male.)

50 to 200. Their colors harmonize well with the sandy-bottoms so that they are usually not so easily detected unless moving about. They all swim together though are easily hauled out in a

seine. Many were quite large and the striped females were especially abundant. Mr. David McCadden and myself found them rather abundant in the surf at Stone Harbor July 25th. They were all more or less pale sandy-brown. Mr. McCadden found it common at Ocean City during the past August.

***Fundulus heteroclitus macrolepidotus* (Walbaum).**

Mummichog.

Taken at Ocean City, August 19th, 1906, by Mr. D. McCadden. Occurs abundantly in ditches on the salt-marsh at Palermo. In Cedar Swamp Creek Mr. T. D. Keim and myself found them above the dam at Petersburg in tide-water, April 16th, 1906. All were small. They also occur in fresh ponds and at the edge of the salt-marsh associated with *Fundulus diaphanus*, to which these remarks will also apply, though the latter is less abundant in the salt water.

Examples taken in Cedar Swamp Creek tide-water at Petersburg, December 31st, 1905, by T. D. Keim and H. W. Fowler, were darker than *F. diaphanus*, and with slaty-bluish sides. Peritoneum and lower surface of head silvery. Iris pearl-color. Streaks on side pale dusky, after death darker. Examples about 2½ inches. They vary in color in the same waters, as some are much darker and others lighter.

Mr. Wm. J. Fox noted a large school on the meadows above Sea Isle City, March 18th, 1906. H. W. Hand, T. D. Keim and myself found them abundant in the tide-marshes near Dennisville in Cape May County during September of 1906. They were mostly small females, but few pearly-spotted males without yellow-edged dorsals, etc.

***Fundulus diaphanus* (Le Sueur).**

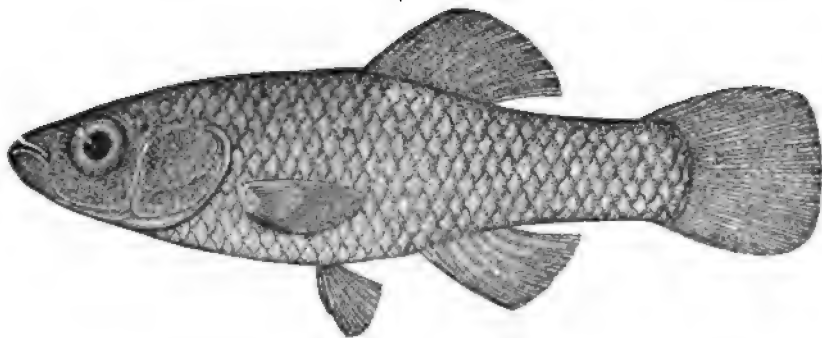
Taken at Ocean City, by Mr. McCadden, August 19th, 1906. Found along the shallow shores of Mantua Creek about and under debris and running in all little inlets, cut-offs, etc., with the incoming tide. All small and apparently non-breeding at Mantua, April 8th, 1906. S. H. Hamilton and H. W. Fowler.

Color in life pale. Peritoneum showing through silvery, also lower surface of head and iris same tint. Muzzle pale translucent brownish. A very pale dusky streak from margin of anal along lower surface of caudal peduncle to caudal. Streak on sides pale. December 31st, 1906. Cedar Swamp Creek at Petersburg, Cape May County. T. D. Keim and H. W. Fowler.

Lucania parva (Baird).

Rain Water Fish.

A single small example was seined by Mr. Fox and myself in Ludlam's Bay, back of Sea Isle City, July 21st, 1906. It was



Rain Water Fish. *Lucania parva* (Baird).

found in the grassy shallows with *Fundulus majalis*, *F. heteroclitus macrolepidotus*, *F. diaphanus*, *Cyprinodon variegatus*, *Opsanus tau*, *Mugil curema* and *Menidia menidia notata*.

Lucania parva Fowler, Science, XXIV, 1906, November 9th, p. 596.

Cyprinodon variegatus Lacépède.

Chub.

Mr. Fox found it at Sea Isle City. I found it quite abundant about the inlet at Cape May during October of 1906. All of the latter had pale yellowish-white abdomens, lower portions of

pectoral, all of ventrals and anal, which turn more or less bright salmon-pink when fresh in alcohol, and back and upper surface turn leaden.

Color in life olivaceous-dusky above, silvery-white on sides and lower surface, and becoming ochraceous on abdomen. Vertical bars on sides dusky-olive like back, with those intervening narrow and paler. Dorsal translucent brownish with dusky spot obscurely at first on first rays basally, and same of median rays. Tips of posterior rays black. Caudal dilute olivaceous-brown with transverse black bar at base. Pectoral, ventral and anal dull chrome-orange, and ventral brightest. Side of head brownish-silvery, also most of body. Iris silvery-brown. Adult. Tide-marsh near Dennisville in Cape May County. September, 1906. H. W. Hand, T. D. Keim and H. W. Fowler. Found associated with *Fundulus heteroclitus macrolepidotus* and *F. diaphanus*.

Family MASTACCEMBELIDÆ.

Tylosurus marinus (Walbaum).

Gar. Sword Fish.

Small examples seen in a cut-off back of Sea Isle City, July 21st, 1906, by Mr. Fox and myself may have been this species. Mr. Fox reported a large school "in parade" found moving across Corson's Inlet late in the summer, with the largest individuals ranging up to about 10 inches which were most likely this species. Mr. McCadden reports a "sword fish," evidently this species from Ocean City during the past August.

Tylosurus raphidoma (Ranzani).

Big Gar.

Head $3\frac{1}{2}$; depth $17\frac{1}{3}$; D. III, 22, 1; A. II, 20; P. I, 12; V. I, 5, 1; scales about 350 in a lateral count from opposite gill-opening to base of caudal, and about 11 more out on latter; 275

scales before dorsal; about 20 scales between origin of dorsal and lateral line in a vertical series; 7 scales between origin of ventral and lateral line in a vertical series; eye $2\frac{1}{2}$ in postocular region; interorbital space $1\frac{7}{8}$; ventral $1\frac{1}{10}$; first branched dorsal ray $1\frac{1}{5}$; first branched anal ray $1\frac{1}{8}$; least depth of caudal-peduncle 4; lower caudal lobe equals eye and postocular region; pectoral $1\frac{1}{5}$. Body robust, its greatest width about $1\frac{1}{8}$ in its greatest depth, sides but slightly compressed and back broadly convex. Caudal peduncle slightly depressed, a little broader than deep, and keel along middle of its side out on base of caudal distinct. Head broad, side flattened and constriction below rather broad. Jaws short, subtruncate at base and rapidly tapering in a slender point depressed above and below. Eye longer than deep, high, and pupil similar. Mouth not altogether closing at bases of jaws. Maxillary nearly reaches front of pupil and nearly concealed. Teeth in jaws knife-shaped, lower fitting outside upper jaw when mouth closes, uniserial along edges,



Gar. *Tylosurus raphidoma* (Ranzani). (Young.)

rather long, more or less equal and rather broad bands of minute ones externally along edges of jaws. Tongue rather narrowly elongate and free. Nasal cavity moderately large, vertical, and impinging above so that internasal space is much less than interorbital. Interorbital space flattened and with a slight depression in middle. Top of head slightly depressed after interorbital space. Posterior margin of preopercle but slightly inclined. Gill-opening forward to front edge of eye. Gill-rakers none. Filaments $1\frac{1}{2}$ in eye horizontally. Isthmus narrowly trenchant. Scales very small, especially above, not arranged in definite series, and cycloid, mostly fallen at present. Base of caudal scaly. About 15 series of scales on cheek. All of opercle and rest of head naked. Lateral line running low, very distinct, of large truncate scales, and posteriorly on side of caudal peduncle

forming a lateral keel. Dorsal placed about last $\frac{2}{9}$ in space between tip of snout and base of caudal, first branched ray highest and others soon after rapidly graduated down with last shortest. Anal similar, and inserted a trifle before dorsal. Caudal deeply lunate, lobes falcate, and lower much longer. Pectoral short, broad and $4\frac{2}{3}$ to ventral. Ventral a little behind last third in space between origin of pectoral and that of anal, and reaching $2\frac{1}{2}$ to latter. Vent close before anal. Color in alcohol not much faded more or less brownish from that noted when fresh. Clear hyaline-greenish on back when fresh. Sides and lower surface silvery-white. Fins transparent hyaline-dusky, ventrals and anal paler. Iris silvery. Length 34 inches. Sea Isle City. August of 1906. Wm. J. Fox.

A number of examples were taken by the fishermen.

Tylosurus raphidoma Fowler, Science, XXIV, November 9th, 1906, p. 596.

Family HEMIRAMPHIDÆ.

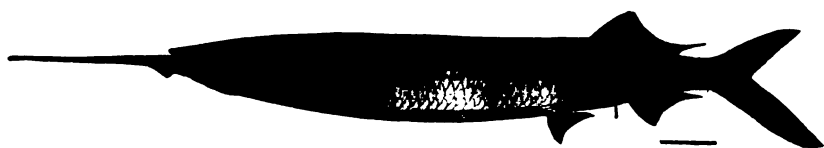
Genus HEMIRAMPHUS Cuvier.

The Balaos.

Hemiramphus brasiliensis (Linnæus).

Balao.

Head, measured to end of beak, $2\frac{2}{5}$; depth $9\frac{1}{6}$; D. II, 12; A. II, 7; scales 56 counted from gill-opening above to base of caudal, and 5 more on latter; 6 scales in a vertical series between



Balao. *Hemiramphus brasiliensis* (Linnæus).

origin of dorsal and lateral line; 35 scales on back medianly before dorsal; snout $3\frac{1}{8}$ in head measured from tip of upper jaw; eye 4; maxillary $3\frac{3}{5}$; interorbital space $4\frac{1}{5}$; second dorsal ray $2\frac{1}{8}$; second anal ray $3\frac{1}{6}$; least depth of caudal peduncle $3\frac{4}{5}$; pectoral $1\frac{1}{3}$; ventral $2\frac{1}{6}$; lower caudal lobe a little more than

head, $2\frac{1}{3}$ to end of beak. Body compressed with sides flattened vertically. Edges of body all rather broadly convex. Caudal peduncle compressed, and its least depth about $\frac{2}{3}$ its length. Head broad, similar to back above, and becoming constricted below, though edge scarcely trenchant. Snout depressed, and its width about $1\frac{1}{2}$ in its length. Eye large, high, a little longer than deep, and pupil of similar shape to orbit. Beak long, depressed, rest of head about $\frac{2}{3}$ its length measured from snout. Maxillary well inclined, reaching $\frac{3}{5}$ of space to orbit, and its distal expansion less than vertical diameter of pupil. Teeth rather firm and conspicuous, perhaps a little larger in upper jaw. Tongue rather broad, and little free in front. Nasal cavity large, high, close in front of eye and about as long. Interorbital space flattened. Gill-rakers about $12 + 25$, slender, and longest $\frac{3}{4}$ of longest filaments which are $\frac{2}{3}$ of eye horizontally. Scales cycloid, mostly all fallen in alcohol, rather narrowly imbricated, and in even longitudinal rows. Lateral line of simple tubes extending along lower side, and rather conspicuous. Origin of dorsal a trifle after last fourth in space between tip of snout and base of caudal, anterior rays highest. Anal inserted a little after origin of dorsal, though nearer base of ventral than that of caudal, and anterior rays elevated. Caudal widely forked, lobes pointed, and upper about $1\frac{1}{2}$ in lower. Pectoral rather long, pointed, and reaching $2\frac{1}{2}$ in space to origin of ventral. Ventral inserted much nearer base of caudal than origin of pectoral, and reaching about $\frac{2}{3}$ to anal. Vent close in front of anal. Color little faded in alcohol from that as noted when fresh in alcohol. Pale or dull hyaline-greenish on back, edge of each pocket dusky. Sides leaden, with line of demarcation separating color of upper surface distinct, and fading out into silvery-white below over all of lower surface. Sides and lower surface of head silvery-white. Upper surface of head dull brownish. Beak and upper jaw dusky. Fins all more or less transparent hyaline, ventrals and anal whitish. Iris silvery. Dorsal and caudal tinted olivaceous, dusky above. Membranes of caudal dusky, and upper lobe tinted more or less dull orange-brown. Posterior edge of caudal slightly dusky. A dull olivaceous blotch on middle of each ventral. Length $7\frac{5}{8}$ inches. Sea Isle City. August 21st, 1906. Wm. J. Fox. Three examples.

Hemiramphus brasiliensis Fowler, Science, XXIV, 1906, November 9th, p. 596.

Euleptorhamphus velox (Poey).

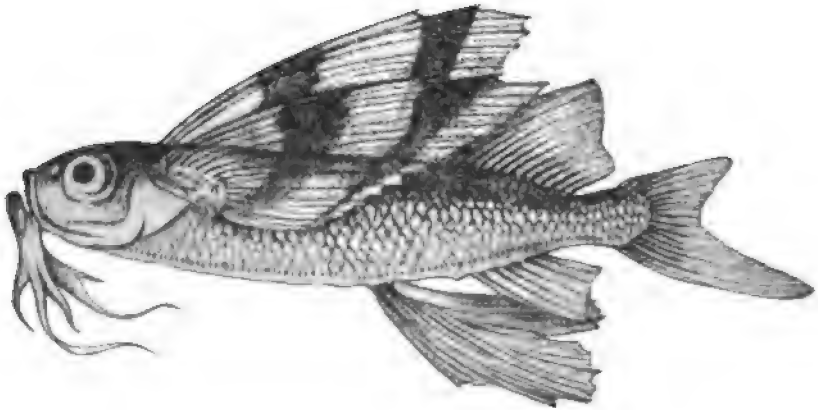
PLATE 94.

Ribbon Half Beak.

Family **EXOCETIDÆ**.

Cypselurus furcatus (Mitchill).

Double Bearded Flying Fish.



Double Bearded Flying Fish. *Cypselurus furcatus* (Mitchill).

Family **ATHERINIDÆ**.

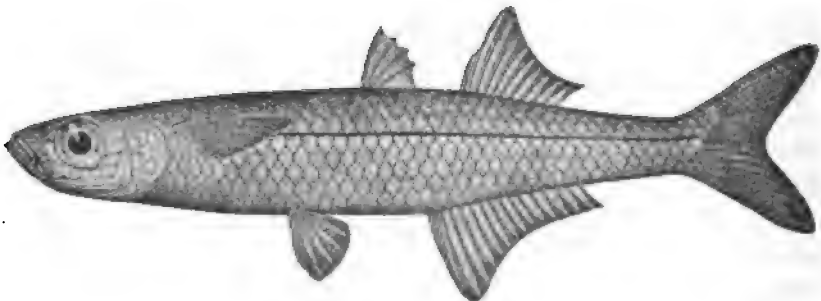
Kirtlandia vagrans lacinata (Jordan and Gilbert).

PLATE 95.

Rough Scaled Silversides.

Menidia beryllina cerea Kendall.

Silversides.



Silversides. *Menidia beryllina cerea* Kendall.

***Menidia menidia notata* (Mitchill).**

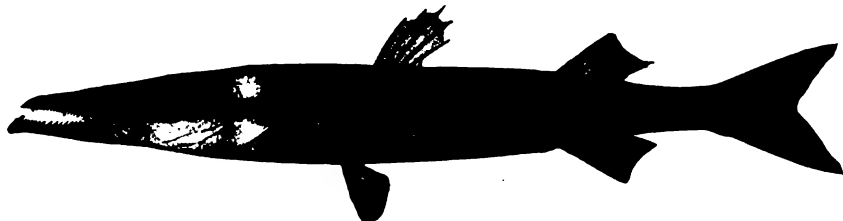
Siversides.

This is abundant at times on the sandy shoals at Sea Isle City. Mr. Fox secured many examples. It is sometimes associated with *Fundulus majalis*, *F. heteroclitus macrolepidotus* and *Cyprinodon variegatus*, on the meadows back of Grassy Sound, where I have found it. Most of these examples however are small. H. Walker Hand, T. D. Keim and myself seined it in Lily Lake, which is fresh-water, at Cape May Point, May 7th, 1905. This is however but a few rods from the salt-water, which in stormy weather is said to wash in. Its association with such fresh-water fishes as *Eupomotis gibbosus*, *Fundulus diaphanus*, *Ameiurus*, etc., which also occur there, is interesting.

Family MUGILIDÆ.***Mugil curema* Valenciennes.**

White Mullet.

Mr. Fox and myself found it abundant in schools in the waters back of Sea Isle City associated more or less with other small fishes. Their usual habit of schooling in the warm sandy shallows and producing quite a commotion on the surface of the water was noticed. They readily skip over the floats of a small seine when hauled ashore. They reach about 6 inches in length in this locality.

Family SPHYRÆNIDÆ.***Sphyræna barracuda* (Walbaum).**

Barracuda. *Sphyræna barracuda* (Walbaum). (Young.)

Family GASTEROSTEIDÆ.

***Pygosteus pungitius* (Linnæus).**

PLATE 96.

Ten Spined Stickleback.

***Gasterosteus bispinosus* Walbaum.**

PLATE 97.

Two Spined Stickleback.

***Apeltes quadracus* (Mitchill).**

Three Spined Stickleback.

An example about $1\frac{3}{4}$ inches long from Cedar Swamp Creek, at Petersburg, Cape May County, shows scarlet ventrals. Lateral streak irregularly dusky from tip of snout, separated from above by pale line. Lower surface of head and abdomen with silvery. Upper surface of head blotched irregularly, ground-color olivaceous-brown. Iris brownish. T. D. Keim and H. W. Fowler. A single example was taken at Sea Isle City by Mr. Wm. J. Fox on June 17th, 1906. I have taken it at Cape May Point.

Family FISTULARIIDÆ.

***Fistularia tabacaria* Linnæus.**

PLATE 98.

Trumpet Fish.

Family SYNGNATHIDÆ.

***Syngnathus fuscus* Storer.**

Pipe Fish.



Pipe Fish. *Syngnathus fuscus* Storer.

Hippocampus hudsonius DeKay.

Sea Horse.

About Cape May it is said to be common in Delaware Bay, and is caught in the oyster-beds according to Mr. H. W. Hand.

Hippocampus punctulatus Guichenot.

PLATE 99.

White Spotted Horse Fish.

Family SCOMBRIDÆ.**Scomber scombrus Linnæus.**

Mackerel.

Two examples, from off Long Branch during the early part of 1903 according to Mr. S. R. Morse, were 19 to 20 inches in length respectively. They showed: Head $4\frac{1}{3}$ and $4\frac{1}{2}$; depth 5; D. XI-II, 11, 5, and X, 11, 9, 5; A. 11, 8, 5 and 11, 9, 5; snout $2\frac{4}{5}$ and 3 in head measured from tip of upper jaw; eye 6 and 8; interorbital space 3 and 4. These are in the State Museum at Trenton.

Mr. Wm. J. Fox reports that a number were taken (evidently this species) April 29th, 1906, at Sea Isle City.

Scomber collas Gmelin.

Mackerel.

Two examples received from Sea Isle City, sent by Mr. Fox, show spots on the side below dark color in 1 example pale, and on another more numerous and with a mottled appearance. The latter has the back also more vermiculated. Several others were also received.

Genus ALBACORA Jordan.

The Great Tunnies.

Albacora thynnus (Linnæus).

Horse Mackerel.

Head $3\frac{1}{2}$; depth $3\frac{4}{5}$; D. XV-II, 12, 8; A. III, II, 7; depth of head $1\frac{1}{3}$ in its length; width of head $1\frac{3}{4}$; mandible $2\frac{1}{4}$; first dorsal spine $1\frac{5}{6}$; first branched dorsal ray $3\frac{1}{3}$; first branched anal ray $3\frac{1}{3}$; upper caudal lobe $1\frac{3}{5}$; pectoral $1\frac{2}{3}$; ventral $2\frac{2}{7}$; greatest width of caudal peduncle $5\frac{1}{2}$; snout $3\frac{1}{2}$ in head measured from tip of upper jaw; eye $6\frac{4}{5}$; maxillary $2\frac{3}{5}$; inter-orbital space 3. Body fusiform, robust, especially anteriorly. Caudal peduncle greatly depressed, slender, and with a broad keel on each side. A small keel above and below this at base of each caudal lobe. Head large, broadly convex above, and more or less conic. Snout a little broader than long. Eye with slight adipose eyelid so that its exposure is deeper than long, and near first third of head. Mouth curved, mandible projecting a little, and maxillary reaching first $\frac{3}{5}$ of eye, its distal expansion about equal to diameter of large pupil. A series of small conic teeth in jaws, best developed along sides of mandible. Teeth on vomer and palatines very minute, scarcely evident. Tongue with a keel on each side, rounded and free in front. Anterior nostril near last third in length of snout. Posterior nostril a vertical slit near front of eye, and about equal to vertical diameter of pupil. Interorbital space evenly convex. Gill-rakers 10+27, compressed, longest about half of filaments, which are equal to snout. Pseudobranchiæ about equal to horizontal eye. Scales on pectoral region forming a corselet, a little large just above basal region of pectoral, and very narrowly imbricated. Corselet extending a little beyond tip of pectoral. Very minute scales in lateral line to caudal peduncle keel, and others out on base of caudal. Origin of spinous dorsal midway between that of rayed dorsal and tip of mandible, graduated down from first or

longest spine, and penultimate 5 spines short and more or less subequal. Rayed dorsal small, nearer origin of spinous fin than base of caudal, and its upper edge emarginate. Anal similar, and inserted just behind base of rayed dorsal. Finlets similar above and below, and decreasing in size posteriorly. Caudal deeply lunate, lobes pointed, and its width at tips of lobes a little less than length of head. Origin of pectoral level with upper edge of eye, opposite that of spinous dorsal, and its tip extending nearly opposite base of twelfth dorsal spine. Ventral inserted opposite origin of pectoral and reaching $\frac{1}{3}$ of space to anal. Color in alcohol greenish-dusky or blackish on back, in some lights posteriorly with slaty reflections. Behind corselet towards caudal, on back, a number of conspicuous dusky or blackish vermiculations. Sides and lower surface with grayish-white shades, overshot with bright mercury-like reflections. Just below and parallel with lateral line anteriorly at end of corselet, 3 dusky lines soon fading out behind. Base of and prepectoral region leaden-gray. Several scattered leaden spots on side below pectoral and corselet. Lower side of head leaden-gray with silvery reflections. Dorsals and caudal brownish, latter with dusky and leaden tints. Finlets more or less slaty. Anal whitish, lobe distally with slaty-gray. Pectoral leaden-gray. Ventral whitish. Iris gray-white. Length 27 inches. Sea Isle City, August 23d, 1906. Wm. J. Fox. This was taken with 3 others, and the next day 2 more were secured. It is not valued as food by the fishermen.

Albacora Jordan must replace *Thunnus* of South, as it is pre-occupied by *Thynnus* Fabricius in butterflies, the latter being apparently merely a variant spelling of the former. The horse mackerels should, therefore, be referred to the genus *Albacora* of Jordan.

Albacora thynnus Fowler, Science, XXIV, 1906, November 9th, p. 596.

Sarda sarda (Bloch).

Bonito.

Color when fresh beautiful violet on back, more or less inclined to blackish and with tints of greenish-blue. On side color changes to a drab-gray. Head slightly pale with leaden tint. Sides of body also with many metallic greenish, bluish and purplish tints in certain lights. A pale area in adipose eyelid behind eye and extending back towards base of pectoral. Oblique narrow blackish lines, more or less longitudinal, sloping up back, and deepest in color above. They are also more or less regular and of even width. Fins all with more or less dusky, front margin of anal and most of inner ventral surface whitish. A narrow silvery ring around pupil, eye otherwise slaty-black. Length 23 inches. One example from Sea Isle City, taken July 4th, 1906. W. J. Fox.

It is a beautiful fish when swimming in the water, the bright bluish of the back being very conspicuous.

Family ISTIOPHORIDÆ.

The Sail Fishes.

Body elongate, much compressed. Caudal peduncle with 2 fleshy crests or keels. Bones of upper jaw consolidated into a sword, which is roundish on edges and spear-like, shorter than *Xiphiidæ*. Teeth in jaws small, persistent and granular. Gills reticulated as in *Xiphiidæ*. Vertebrae $12+12=24$, elongate and hour-glass shaped. Neural and hæmal spines flag-like. Ribs well developed. Air-vessel very large, sacculate, of numerous separate divisions. Intestine short, straight. Body covered with elongate scutes. Dorsal single, or divided into 2 contiguous portions, first much longer than second, fin-rays distinct, and first rays distinctly spinous. Anal divided. Last rays of dorsal and anal suctorial. Ventrals attached to pelvic arch, each with 1 or 2 rays.

Oceanic or pelagic fishes resembling the sword fishes, but smaller in size. Several fossil forms have been recorded. One genus on our shores.

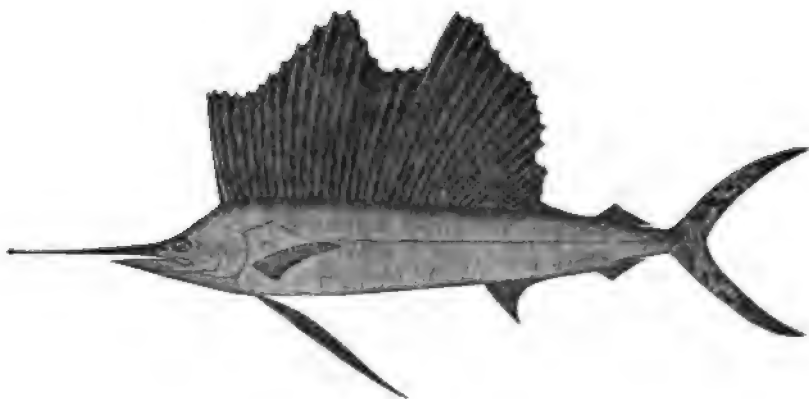
Genus *ISTIOPHORUS* Lacépède.

The Sail Fishes.

Istiophorus nigricans (Lacépède).

Sail Fish.

Head, measured to tip of beak, $1\frac{3}{5}$; depth $9\frac{3}{4}$; D. XLII, 11, 6, 1; A. XIV, 8, 1; P. 1, 16; V. 1, 1, 1; scales about 213 in lateral



Sail Fish. *Istiophorus nigricans* (Lacépède).

line and about 13 more counted to base of caudal; about 18? scales in a vertical series between origin of second dorsal and lateral line; about 24 scales in a vertical series between origin of anal and lateral line; depth of head at occiput $4\frac{1}{6}$; width of head $9\frac{1}{3}$; postocular part of head 5 in rest of its length; mandible $1\frac{4}{7}$ in head measured from its own tip; twenty-first dorsal spine $1\frac{1}{3}$ in head measured from tip of beak; lower caudal lobe, measured from its origin, $2\frac{4}{7}$; ventral $1\frac{3}{5}$; eye $3\frac{2}{3}$ in postocular region; interorbital space $2\frac{3}{5}$; first dorsal ray $3\frac{1}{10}$; sixth anal spine $1\frac{3}{5}$; first anal ray $3\frac{4}{5}$; least depth of caudal peduncle $3\frac{2}{5}$; pectoral $1\frac{1}{4}$. Body long, slender, strongly compressed, and with

similar profiles tapering back from occiput, which is point of greatest depth, to caudal peduncle. Lower half of body more or less constricted its entire length, though edges not trenchant. Predorsal region with edge rather narrowly convex, though without median keel. Upper and lower surface of caudal peduncle becoming rather flattened, and with a depression at origin of each caudal lobe. Least depth of caudal peduncle about a third of its length. Head attenuated to a long slender beak, or tip of snout, which is equal to rest of its length if measured from tip of closed mandible. Head strongly compressed, slightly convergent below, and broadly convex above. Beak very slender, ending in a sharp point, quadrangular at base, and rather depressed or flattened slightly for greater part distally. Along each superior edge a narrow cutaneous margin extending from above outer portion of mandible to near tip of beak. A slight narrow series of asperities along each edge of beak below continued back within mouth, and about midway in their course rather obsolete. In this portion of upper jaw they are narrow, though all triangular space anterior to inner buccal membrane minutely asperous, asperities arranged in small closely situated patches. Edges of mandible with asperities in rather broad bands anteriorly and at symphysis, though becoming more or less uniform narrow posteriorly. Anterior interspace obsoletely similar to that of upper jaw. Eye rather deeply ellipsoid, falling a little nearer edge of opercle posteriorly than end of mandible, and placed a little high in head. Maxillary small, with preorbital only covering over anterior portion, well exposed, and reaching opposite posterior margin of eye. Mandible elongately subconic, becoming slightly quadrangular just after tip. Tongue thick and not free. Nostrils close together or adjoining, on side of snout above, and anterior to eye for a space about $2\frac{1}{2}$ in horizontal diameter of latter. Interorbital space broadly and slightly convex. Gill-openings vertical, extending but slightly forward as a shallow median branchiostegal notch. No rakers. Gill-filaments very numerous, large, and longest a trifle more than eye horizontally. Branchiostegals 7. Scales thin, along dorsal edge elongate, lanceolate, and slender, all more or less falling. On body generally most have fallen except those

in lateral line, where they appear as rounded and cycloid, and arranged in rather regular longitudinal series. At each caudal lobe basally a lateral keel. A series of about a dozen scales on cheek. Lateral line extending till opposite origins of caudal lobes, and with a highly convex arch in front, which curves down opposite tip of pectoral. Scales of lateral line rather small and pointed, each with a single simple pore. Spinous dorsal very large, of long flexible simple radii or spines, only tips of which are slightly free, and fin joined to second dorsal by basal membrane. Antero-medially fin highest, and radii more or less regularly graduated down from highest point. Origin of fin begins far anteriorly or but a trifle behind middle of postocular region. Second dorsal far posterior, very small, though firm, and falling near last fifth in space between base of caudal and origin of pectoral. First anal with fifth ray longest, others graduated down, and origin of fin falling a little nearer base of caudal than origin of ventral. Second anal low, of more or less uniform height, firm, tough, last ray longer than others and inserted about opposite origin of second dorsal. Caudal widely forked, lobes very slender, falcate and about equal. Pectoral short, broad and rounded, with upper rays longest. Ventral very long, second ray exceedingly enlarged and compressed, though falling a little short of first anal. In alcohol color has not faded from that noted below. Color when fresh in formalin, body slaty-plumbeous, inclining to whitish on under or lower surface. Back above blackish. Scales on body all with more or less silver-leadен reflections. Lateral line distinctly silvery-leadен. Beak dusky above, otherwise dark brownish. Head above with dusky. Sides above with slaty-plumbeous tints. Sides of head leadен-plumbeous, and lower surface and mandible below becoming opaque silver-white. Edge of lower jaw dusky. Iris silvery. Inside of mouth pale or whitish, anterior inner surfaces of jaws dull dusky. Dorsals blackish, also ventrals. Anal whitish. Caudal with grayish ground-color variegated with dusky, pale slaty on scaly base. Spinous anal grayish-white, anterior elongated portion dusky. Inside of gill-opening pale. Length 24 inches. Sea Isle City. August 24th, 1906. Wm. J. Fox.

This interesting fish is only known from our limits by the record of the above example. It is a pelagic form of the warmer Atlantic waters and is evidently but a straggler to our shores. Said to reach a length of 6 feet.

Istiophorus nigricans Fowler, Science, XXIV, 1906, November 9th, p. 596.

Family CARANGIDÆ.

Seriola zonata (Mitchill).

Hard Tail.

Seriola lalandi Valenciennes.

Hard Tail.

Head $3\frac{1}{4}$; depth $3\frac{1}{6}$; D. I, VI-I, 34, 1; A. I-I, 22, 1; scales about 175 in lateral line to base of caudal and about a dozen somewhat enlarged on latter; about 24 scales between origin of spinous dorsal and lateral line in a vertical series; about 34 scales in a vertical series between origin of spinous anal and lateral line; mandible 2 in head; third dorsal spine $4\frac{1}{2}$; first branched dorsal ray $2\frac{2}{5}$; first branched anal ray $2\frac{7}{8}$; least depth of caudal peduncle 6; lower caudal lobe $1\frac{1}{3}$; pectoral $2\frac{1}{6}$; ventral $1\frac{7}{8}$; snout 3 in head measured from tip of upper jaw; eye 5; maxillary $2\frac{2}{7}$; interorbital space $3\frac{1}{6}$. Body elongate, fusiform, well compressed, and profile similar. Head compressed and upper profile a little more convex than lower. Snout convex over surface, and broad as long. Eye rounded, a little anterior, high, and adipose eyelid rather thick, though not encroaching much on iris. Mouth horizontally inclined, mandible protruding a little, and lips fleshy. Maxillary reaches first $\frac{3}{7}$ in length of iris, and with its distal expansion nearly equal to orbit. Width of supplemental maxillary about $\frac{2}{3}$ of pupil, which is elongated similarly to orbit. Broad bands of villiform teeth in jaws, on vomer, palatines and tongue. Tongue rather long, rounded in front, and free. Nostrils together, of similar size, near last third in

length of snout on its side, and in a slight depression. Interorbital space convexly elevated. Gill-rakers III, 3 + 12, 1, lanceolate, and longest a little longer than longest filaments, or $1\frac{1}{2}$ in eye horizontally. Small scales on body and side of head, about 14 series on cheek. Low basal scaly sheaths to rayed dorsal and anal in front. Lateral line a little convex at first or for about first $\frac{4}{7}$ its length, and forming a low obsolete keel along side of caudal peduncle. Spinous dorsal low, graduated down from second or longest spine, and its insertion falling about first fourth in length of pectoral. Rayed dorsal inserted a little nearer tip of mandible than base of caudal, and anteriorly with rays longest, though not forming a lobe. Rayed anal similar, and inserted midway between origin of pectoral and base of caudal. Anal spine small and inconspicuous. Caudal forked, and equal lobes pointed. Pectoral short, broad, and about $\frac{5}{6}$ length of depressed ventral. Ventral about half way to origin of rayed anal, with a deep basal groove joining its fellow posteriorly, and extending back so that both fins are depressible within. Vent in last third between tip of depressed ventral and origin of spinous anal. Color in alcohol faded dull drab-brown above, and brownish-white below. Fins all more or less dark brownish, and ventral paler or whitish. Margin of rayed dorsal, upper caudal lobe, and posterior margin of lower caudal lobe, dusky. Anal with a broad dusky longitudinal band from middle of front rays back. Only narrow pale edge is exposed on shorter rays and edge broad pale on anterior. Ends of ventral rays becoming dusky. Length 11 inches. Sea Isle City. July 5th, 1906. Wm. J. Fox.

Color of the above when fresh olivaceous-gray above inclining paler on sides and becoming whitish below. Sides more or less overshot with brassy-golden tints, same also on side of head. Dorsals and caudal grayish, edges narrowly dusky. Anal whitish with a median longitudinal grayish band. Pectoral pale gray-brown. Ventral rays, and especially most of inside of fin, chalky-white, subaxillary region pinkish-orange tinted, and outer portion dusky. Iris brownish with narrow pale or whitish ring around pupil.

Another taken on the 15th of the same month was colored as follows when fresh. Back more or less purplish-brown above

till level with eye, line of demarcation bounded by a deep amber longitudinal band extending from eye to caudal peduncle, most distinct on upper costal region. Sides below and lower surface amber or citron-yellowish. Cheek and thorax more or less brassy, also opercle. Upper surface of head warm brownish, snout and lore included. Lips pale brownish. Maxillary posteriorly, and mandible below, yellowish. Iris warm orange-brown, narrow ring of orange encircling pupil. Membranes of spinous dorsal warm dusky, spines more pale olive-yellowish with dusky front margins. Rayed dorsal olivaceous-brown of more or less warm shade, submarginally warm terracotta-brown and edge of fin dusky. Caudal pale warm brownish basally, outer ends of each lobe grayish with submarginal band of red on median rays of fin and fading into dilute olivaceous-yellow above and below. Posterior margin of caudal dusky. Pectoral pinkish, becoming dusky along upper margin. Ventral with bases of rays and axillary region milky-white, otherwise with more or less orange-dusky, especially distally, and each ray and spine yellowish. Anal yellowish-brown, base of fin pale brown with submarginal orange tint and edge of fin pale or whitish. Lower surface of caudal peduncle whitish. About 5 broad indistinct transverse bands of amber-yellow on side of body, first at base of pectoral, second at tip of pectoral, third midway between tip of pectoral and front of anal, fourth over middle of base of anal, fifth at posterior base of, and possibly a sixth, at base of caudal. Peritoneum silvery. Inside of gill-opening whitish. Length $10\frac{1}{8}$ inches.

I examined a portion of a large example taken August 10, 1906, in the Sea Isle City pounds. It was said to have weighed 80 pounds.

Seriola lalandi Fowler, Science, XXIV, 1906, November 9th, p. 596.

Genus TRACHUROPS Gill.

The Big Eyed Scads.

Trachurops crumenophthalmus (Bloch).

PLATE 100.

Goggle Eye Scad. Goggle Eye.

Distinguished from all our other members of the family by a deep cross-furrow at junction of shoulder-girdle with isthmus, within gill-opening.

This is only known within our limits from Dr. Gill's record of an example taken among a school of blue fish at Beesley's Point many years ago. This record I overlooked in the "Fishes of New Jersey."

Trachurops crumenophthalmus Gill, Proc. Acad. Nat. Sci. Phila., 1862, p. 432.

Genus BLEPHARIS Cuvier.

The Thread Mackerels.

Blepharis crinitus (Mitchill).

PLATE 101.

Thread Mackerel. Thread Fish.

Head 3; depth $1\frac{1}{16}$; D. VII-I-1, 19; A. II-I, 16; P. II, 18; V. I, 5; about a dozen scutes developed along side of caudal peduncle; mandible $2\frac{1}{4}$ in head; width of head $2\frac{3}{5}$; pectoral $1\frac{1}{10}$; lower caudal lobe $1\frac{1}{8}$; snout $3\frac{1}{8}$ in head, measured from tip of upper jaw; eye $3\frac{1}{10}$; maxillary $2\frac{3}{5}$; interorbital space 3; least depth of caudal peduncle 6; ventral $2\frac{1}{4}$ in head and trunk. Body strongly compressed, somewhat trapezoidal, nearly equally elevated above and below to origin of rayed dorsal and anal, at which point greatest depth of body falls. At former point back forms a nearly right-angled triangle, and below abdomen forms a slightly obtuse angle at origin of anal. Anteriorly profiles slightly convex to their summits, and posteriorly

upper a trifle convex in its inclination while lower is almost straight to caudal peduncle. Edges of body slightly trenchant. Caudal peduncle compressed, slender, and its least depth about half its length. Head moderate, well compressed, deep, and upper profile evenly convex from tip of snout to occiput, after which it is straight to origin of rayed dorsal. Lower profile of head slightly concave to ventral process close in front of base of ventral. Snout short, long as broad and with convex surface. Eye large, a trifle longer than deep, nearly midway in depth of head, and a little anterior. Pupil a little longer than deep. Mouth well inclined, moderate, curved a little in gape, and mandible protruding a little. Maxillary narrow, well inclined, and reaching front margin of iris, distal expansion about $\frac{2}{3}$ of horizontal diameter of pupil. Lips rather thin. Teeth moderately small, conic and in rather narrow bands in jaws. Small teeth in bands on vomer and palatines. Tongue rather thick, flattened above, slightly minutely asperous in middle, and free in front. Nostrils near together, close in front of eye on side of snout, anterior simple, and posterior a deep slit vertically. Interorbital space broadly convex, becoming trenchant gradually behind. Preorbital $1\frac{1}{3}$ in eye horizontally. Gill-opening extending forward to front margin of eye. Gill-rakers $5 + 15$, lanceolate, and half of eye horizontally. Filaments about $\frac{4}{7}$ of latter. Isthmus narrow and slightly rounded. Body apparently naked, or with traces of minute imbedded scales on posterior portion of trunk, about caudal peduncle and base of caudal. Lateral line conspicuous, complete, strongly convex for first half of its course, and posterior or straight portion with obsolete or indistinct scutes or bony scales forming a narrow keel along side of caudal peduncle. Spinous dorsal low, its origin falling about posterior margin of gill-opening in vertical, spines slender, short and second longest, others graduated more or less down. Rayed dorsal with its origin falling well before that of rayed anal or about opposite that of spinous anal, and with first 7 rays elongated into slender thread-like filaments, of which first, which is longest, is as long again as entire length of fish. Other filaments graduated down to last which is shortest, though second but little shorter than first. Posterior non-fila-

mentous dorsal rays subequal and short. Spinous anal of 2 small short weak spines with first about last fourth in postdorsal region, and second a trifle longer. Rayed anal similar to soft dorsal only filaments 3, shorter, and first branched ray about equal to space between tip of mandible and tips of median or shortest caudal rays. Caudal well forked, lobes slender, pointed and equal. Pectoral a little large, upper rays longest, and reaching $\frac{3}{7}$ of space to base of caudal. Ventral long, inserted a little before origin of pectoral, reaching $\frac{3}{5}$ to base of caudal, and second branched ray longest. Vent first $\frac{3}{5}$ in postventral region. Color in alcohol scarcely different from example noted below with same data, when fresh. Broad dark transverse bands distinct. Length $4\frac{3}{8}$ inches. Sea Isle City. August 24th, 1906. Wm. J. Fox.

Color when fresh. Back more or less plumbeous, deepening a little above at predorsal ridge. Head and trunk everywhere bright metallic mercury or silvery-white, with bright reflections of steel-bluish, bluish-green and lavender. On back above traces of about 6 pale though fairly well-defined dull brownish vertical or transverse bands, each a little broader than interspace, a little darker above and fading out below. First indistinct, extends from occiput down to opercle above. Second, very indistinct, begins just before origin of rayed dorsal at apex of dorsal profile. Third begins below anterior dorsal rays, fourth from median rays, fifth from posterior rays, and all these bands most pronounced. Sixth pale, placed at last rays, and on front of caudal peduncle. Vertical fins pale brownish generally, elongated dorsal and anal becoming black, which color extends well toward bases of first three rays. Pectoral transparent or dilute brownish. Ventral jet-black. Opercle with a tinge of dusky. Iris silvery-white. Jaws translucent whitish, with a few fine dusky specks. Length 3 inches. August 6th, 1906.

It did not seem to be known to the fishermen. The generic name *Blepharis* Cuvier must replace *Alectis* of Rafinesque, which I had adopted previously, as the latter is a substitute for *Gallus* of Lacépède, which is preoccupied in birds. Lacépède's *Gallus*, however, is congeneric with *Selene* Lacépède, as its type by tautonymy is *Zeus gallus* Linnaeus. Cuvier's name is not preoccupied in zoology, though in botany it had previously been used,

and therefore is perfectly valid. It is, however, based on the East Indian *Zeus ciliaris* of Bloch, a species which I have not seen. My error in its rejection was due to the statements of authors that it was preoccupied.

Blepharichthys crinitus Fowler, Science, XXIV, 1906, November 9th, p. 596.

Vomer setapinnis (Mitchill).

Moon Fish.

Head 3; depth $1\frac{3}{4}$; D. VIII-I, 21, 1; A. II-I, 18, 1; scales about 184 according to tubes, counted in lateral line to base of caudal; width of head 3 in its length, measured from space between tip of mandible and upper posterior margin of gill-opening; mandible $2\frac{3}{7}$; first dorsal ray 3; first anal ray 5; caudal $1\frac{1}{4}$; pectoral $1\frac{1}{16}$; snout $2\frac{1}{5}$ in head, measured between tip of upper jaw and posterior margin of gill-opening above; eye $4\frac{1}{2}$; maxillary $2\frac{2}{3}$; interorbital space $4\frac{2}{3}$; least depth of caudal peduncle 7. Body greatly compressed, deep, of oblong appearance, and with greatest depth at spinous dorsal. Upper profile abrupt in front and elevated till over eye, after which slightly inclined convexly to origin of rayed dorsal, and from there rather convex down to slender caudal peduncle. Lower profile rather evenly convex from tip of mandible back to origin of rayed anal and then very slightly convex up to caudal peduncle. Edges of body trenchant. Caudal peduncle small, compressed, and its least depth about half its length. Head deep, compressed, and anterior profile slightly concave in front of eye. Snout narrowly compressed and its width a trifle less than half its length. Eye circular, a trifle posterior, and about midway in depth of head. Mouth obliquely inclined, rather small, and compressed, mandible protruding. Maxillary not quite reaching opposite front margin of eye, and its distal expansion $1\frac{1}{2}$ in latter. Teeth minute, and in narrow bands in jaws. No vomerine or palatine teeth. Tongue narrow, slender, tip a little obtuse and free. Nostrils as 2 short vertical slits close together, and upper a little higher or about opposite upper part of iris. Interorbital

space convexly trenchant. Preorbital broad, thin, edge largely overlapping maxillary above. Margin of preopercle forming a very obtuse angle. Gill-rakers 6 + 26, 1, lanceolate, a trifle longer than filaments or about $\frac{2}{3}$ of eye. Scales minute, more or less evident on posterior portion of body, and imbedded. Curved part of lateral line a trifle less than straight part, scales in its course rather large, and forming slight keel along side of caudal peduncle. Second erect dorsal spine longest, short, and others all very short. Rayed dorsal inserted midway between tip of snout and base of caudal, and rays graduated down from first branched. Rayed anal similar, and inserted about opposite origin of former. Caudal widely forked, lobes pointed. Pectoral long, falcate, and reaching half way to base of caudal. Ventral small, and inserted opposite origin of pectoral. Color in alcohol more or less pale brownish-white with brassy-silvery reflections, and back dull purplish-brown. Fins pale brownish, upper part of rayed dorsal lobe dusky, also outer portions of caudal lobes. Iris brassy. Length 7 inches. Sea Isle City. July, 1906. Wm. J. Fox.

Color when fresh of another example beautiful silvery-white with brilliant though faint tints of purplish, azure, lavender and golden reflected everywhere on trunk and head. Interorbital space whitish. Front or median edge of jaws dusky, and head otherwise all more or less silvery-whitish. Iris bright silvery-white. Inside of gill-opening whitish. Small dorsal spines grayish-dusky. Rayed dorsal dilute olivaceous-brown, margin, especially of lobe, rather broadly dull dusky. Upper surface of caudal peduncle dull olivaceous. Caudal dilute greenish-yellow, posterior margin inclining to dusky, and lower edge of lower lobe paler than that of upper. Anal grayish-white, transparent. Pectoral and ventral dilute transparent whitish. Length $6\frac{1}{4}$ inches.

This was first observed by Mr. Fox during the summer of 1905, though no examples were then secured. During the summer of the past year he found quite a number.

Vomer setapinnis Fowler, Science, XXIV, 1906, November 9th, p. 596.

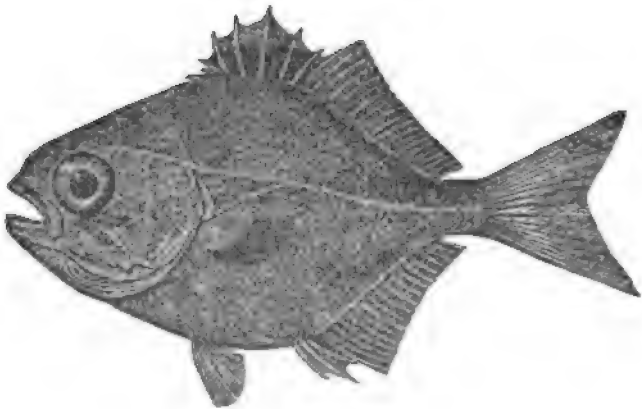
Selene vomer (Linnæus).

Moon Fish.

Color when fresh bright silvery with beautiful iridescent bluish and purplish reflections. About 7 vertical brownish bands, first from occiput down to upper edge of eye and continued below toward end of maxillary, second from base of long filamentous dorsal spines down toward opercle, third between second and fourth which latter begins at elongated dorsal spines and extends to anal spines, fifth at beginning of straight part of lateral line, sixth at tip of pectoral, and seventh at last dorsal ray. There is probably another at base of caudal. Spinous dorsal filaments and entire ventral jet-black. Rayed dorsal and anal with long lobes slightly olivaceous medianly and their edges anteriorly and above largely dusky, rest of fin transparent whitish. Caudal largely pale and transparent grayish, upper edge slightly darker, and middle of each lobe basally somewhat light olive-green. Pectoral transparent whitish. Iris silvery. Length $3\frac{1}{4}$ inches. Palermo, Cape May County. October 10th, 1906. G. Z. Hartman.

Trachinotus falcatus (Linnæus).

Round Pampano.

Round Pampano. *Trachinotus falcatus* (Linnæus). (Young.)

Trachinotus carolinus (Linnæus).

Pampano.

Mr. Fox obtained it at Sea Isle City. Mr. McCadden and myself found it abundant in the surf at Stone Harbor, July 25th, 1906. They were of the usual bright silvery coloration, with yellowish on the fins.

Family **POMATOMIDÆ**.

Pomatomus saltatrix (Linnæus).

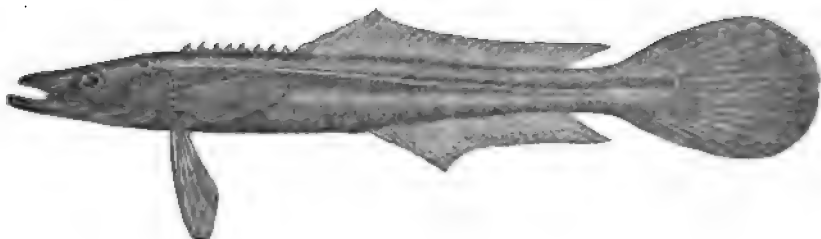
Blue Fish.

Said to enter the Tuckahoe as far as tide-water.

Family **RACHYCENTRIDÆ**.

Rachycentron canadus (Linnæus).

Crab Eater.



Crab Eater. *Rachycentron canadus* (Linnæus). (Young.)

Family **STROMATEIDÆ**.

Poronotus triacanthus (Peck).

Butter Fish.

Color when fresh bright shining plumbeous-silvery generally, with a sort of dusted or shaded gray tint on back, and becoming somewhat brownish on head above. Body most everywhere with more or less pale gray dustings. Body also with beautiful green-

ish and lavender metallic reflections. Dorsal and caudal pale brownish-gray, latter more gray. Anal silvery along base, and becoming pale brownish-gray marginally. Pectoral dull gray, margin above at base slightly dusky. Iris silvery. Lips pale brownish. Inside of gill-opening dusted dusky above, otherwise whitish. Length 12 inches. Sea Isle City. June 17th, 1906. Wm. J. Fox.

After death the colors fade to more or less brassy on the sides, back becoming more plumbeous or leaden-gray and the belly whitish. This example is the largest I ever saw, and was noted by the fishermen as apparently unusual.

I follow Dr. Jordan in referring the *Centrolophidae* and *No-meidae* to the present family.

***Palinurichthys perciformis* (Mitchill).**

Black Rudder Fish.

Head $3\frac{1}{4}$; depth $2\frac{7}{8}$; D. VII, 11, 20, 1; A. III, 1, 16; scales about 90 in lateral line to base of caudal and about 10 more large ones on latter; 14 scales in a vertical series between origin of spinous dorsal and lateral line; 26 scales in a vertical series between origin of spinous anal and lateral line; snout $3\frac{1}{3}$ in head measured from its own tip; eye $5\frac{3}{5}$; mandible $2\frac{1}{4}$; maxillary $2\frac{9}{10}$; interorbital space $2\frac{3}{4}$; second branched dorsal ray $1\frac{3}{4}$; second branched anal ray about 2; caudal $1\frac{1}{3}$; least depth of caudal peduncle 3; pectoral 3; ventral $1\frac{3}{5}$. Body compressed, and becoming somewhat trenchant towards edges. Head deep, compressed, and obtuse or bluntly convex in front. Snout short, its length about $1\frac{1}{2}$ in its width, obliquely vertical in front, and forming a broad obtuse angle or protrusion about midway in its length above to interorbital space. Eye about midway in depth of head, near first third of its length. Adipose eyelid rather narrow. Mouth well inclined, and jaws even. Maxillary exposed, narrow, and reaching a trifle beyond front edge of eye, its distal expansion about $2\frac{1}{2}$ in orbit. A single series of small uniform teeth in each jaw. No teeth on vomer and palatines. Tongue smooth, rather large, rounded and free. Nostrils mid-

way on side of snout, near together, and posterior a short vertical slit. Interorbital space elevated convexly. Margin of preopercle rather weakly spinescent, and expanding at lower corner. Gill-opening forward midway in loreal region. Gill-rakers 5+17, slender, lanceolate, and longest $1\frac{1}{2}$ in eye. Gill-filaments almost equal eye. Isthmus bevelled in front. Scales cycloid, in somewhat undulated longitudinal series, and becoming small and crowded on edges of body. Pectoral naked, and other fins all more or less entirely covered with minute crowded scales. Head naked, and more or less entirely covered with mucous pores, whole appearance finely corrugated or rugose, though smooth to touch. Spinous dorsal inserted midway between middle of eye and tip of last spine, all spines small, weak and graduated down from about fourth, which is longest. Rayed dorsal inserted nearer tip of snout than base of caudal, and graduated down from front of fin, which is highest at first branched rays. Spinous anal inserted about midway between posterior margin of eye and base of caudal, and spines graduated to third which is longest. Rayed anal similar to rayed dorsal. Caudal broad, and deeply emarginate. Pectoral broad, and upper rays longest, reaching $\frac{4}{5}$ to vent. Ventral inserted below bases of lowermost pectoral rays, and reaching $\frac{4}{5}$ to vent. Ventral spine about $\frac{3}{7}$ length of fin. Color in alcohol blackish-brown, scales with dusky reticulated appearance, and all of fins blackish. Iris slaty. Length $11\frac{3}{4}$ inches. Sea Isle City. July 1906. Wm. J. Fox.

Color of above when fresh, livid blackish-slaty with somewhat slaty-olivaceous tinge. Back, upper surface of head and caudal peduncle, everywhere finely speckled with blackish or dusky, these specks rather fine and indistinct. Lower side of body and abdomen dull soiled dusky-gray with very dilute blue-green tinge. Head all more or less dusky, especially lips and jaws. Fins all blackish, perhaps color most intense distally, and membranes with livid slaty tinge. Radii of ventral, and spine, slightly creamy. Iris bright colored, a broad circle of bright orange around pupil in life, and an outer circle to this silvery. Inside of gill-opening with dusky.

Three others were taken by Mr. Fox at the same locality during the past summer. During the summer of 1900 Mr. David McCadden reported about 6 examples taken from a floating soap-box at Stone Harbor. The box had evidently floated some time and was partly filled with water, the fish probably having gained entrance through one of the spaces made by the removal of a part of the lid. Mr. McCadden further informs me that this fish has been reported from about wrecks, floating logs, boxes, etc., at the same place.

Palinurichthys perciformis Fowler, Science, XXV, 1906, November 9th, p. 596.

Family APHREDODERIDÆ.

Aphredoderus sayanus (Gilliams).

Pirate Perch.

Color when fresh deep rich dusky-brown, center of each scale more brownish than margin. Side scarcely paler than back. Head colored on upper surface like back, and also well down on its sides. Lower surface of head, belly and abdomen more or less buff-white. Lower side of head and abdomen with dusky-brown specks extending below into pale color of these parts, especially latter, which is nearly completely specked. Lips brownish. Iris pale brownish. Dorsal neutral dusky-black, becoming pale or grayish, with a narrow pale sub-basal longitudinal band, and base itself narrowly black. Caudal blackish, its upper and posterior margins narrowly whitish, fin becoming paler neutral tint basally. Anal with narrow dusky base, then a duffuse pale yellowish-buff tint becoming merged into blackish distal portion of fin, transition marked by neutral shades. Pectoral dull olive or yellow-buff, distally blackish or dusky, and basally with a brownish blotch. Ventral buffy-yellow, becoming somewhat neutral distally, and sprinkled with a few brownish or pale dusky specks. Length $4\frac{3}{8}$ inches. In a cut-off of Mantua Creek, above Mantua. April 8th, 1906. S. H. Hamilton and H. W. Fowler.

Family MICROPTERIDÆ.

Acantharchus pomotis (Baird).

Mud Sun Fish.

Color in life deep olive generally, sides brassy-golden shaded with paler areas, especially on cheek and opercle. Lines on trunk and sides of head deeper olive than ground-color. Opercular spot black. Lower surface of head paler than upper surface. Dorsals, anal and caudal dusky-olive, and base of caudal more dusky than broad pale submargin, edge but slightly dusky. Dorsals also olivaceous, and rayed fin with a longitudinal dusky bar. Rayed anal similar, only dark bar begins on spinous fin. Pectoral transparent or dilute saffron-olive. Ventral transparent, front edge white, and first ray dusky-olive. Iris with olivaceous-brown encircling pupil, around which is a paler and lighter ring. Length 5 inches. Affluent of Crosswicks Creek, near Trenton. July 15th, 1906. Dr. C. C. Abbott, T. D. Keim and H. W. Fowler.

Color in life generally dark dull olivaceous-brown, inclining to more paler olivaceous on lower surface of head and abdomen. Body marked with 5 longitudinal dusky-olive streaks. Uppermost of these close to base of dorsal, next just above lateral line inclusive to just below lateral line broader, and fifth extending from infraorbital to axil of pectoral and back where it joins upper. Below this, lowest extending from articular bone just below base of pectoral and then continued to base of anal, but not on caudal peduncle. Bars on head distinct, especially postocular and 1 from infraorbital. Opercular blotch a little smaller than orbit, with posterior golden-olive margin. Fins dusky, soft dorsal paler. Pectoral and ventral dusky, paler than unpaired fins, though base of former darker. Anterior margin of ventral slaty, base of fin and innermost ray pale. Lower margin of anal slaty. Iris olive, ring around pupil slightly dusky. Length about $5\frac{1}{2}$ inches. Forks of Cedar Swamp Creek, Cape May County. December 31st, 1905. T. D. Keim and H. W. Fowler. Young much darker, with golden reflections on opercle and chest, side

with about 4 broad indistinctly defined longitudinal bands. Color very dark, otherwise similar to adult. Margin of ventral paler in examples 3 inches long.

***Enneacanthus gloriosus* (Holbrook).**

Blue Spotted Sun Fish.

Color in life muddy-brown speckled with brilliant gilded spots, with azure and blue-green reflections. These spots extending on bases of caudal and dorsal, and on head, though not on predorsal region. Iris, rayed dorsal and anal wine-color, and same tint on caudal basally, though margin dusky. Pectoral translucent with diluted olive. Ventral pale, spine and first ray dusky with its tip slaty and first 2 rays dusky wine-color. After death colors become darker, more of a deep greenish-olive, and abdomen remains pale. Opercle with black blotch, smaller than pupil, and margined above and below with gilt-like spots. Affluent of Crosswicks Creek, near Trenton. July 15th, 1906. Dr. C. C. Abbott, T. D. Keim and H. W. Fowler.

***Enneacanthus obesus* (Girard).**

PLATE 102.

Banded Spotted Sun Fish.

Small spotted sunfish, most likely this species, and the last, are reported to occur in the small cedar-stained affluents and ponds about Dennisville in Cape May County.

***Lepomis phenax* (Jordan).**

Deceptive Sun Fish.

There are about 15 scales between lateral line and origin of spinous anal, counted obliquely forward.

Lepomis auritus (Linnæus).

Long Eared Sun Fish.

Color in life olive-brown above, center of each scale darker, and edges shot with metallic greenish in some lights. Head more or less translucent brownish, several blue-green streaks before eye, and 1 running up close below. Fins translucent dusky, margin of rayed dorsal pale grayish-white. Sides of body also tinged grayish with saffron tints of abdomen extending up to lateral line. Breast gamboge. Some of scales on belly and pre-ventral region tinted vermilion. Opercular flap black, with a slight blue-green line above and below. Iris dusky-brown. Lower surface of head translucent brownish, tinted dull gamboge in some lights. Pectoral and caudal with olivaceous tints. Margin of ventral in front and behind grayish-white. Length about 6 inches. Taken on salt-clam in the Rancocas Creek at Centerton, Burlington County, October 14th, 1906, where they are abundant. T. D. Keim and H. W. Fowler.

Eupomotis gibbosus (Linnæus).

Sun Fish. Common Sun Fish.

Color in life with upper surface olivaceous-dusky, and vertical fins with more or less of same tints. Each scale on back with a vertical dusky bar, and pale ones extending below level of eye. Belly golden or coppery-amber. Several dusky azure-green streaks radiate from eye, turning to coppery-amber. Iris brownish. Jaws translucent brownish. A black blotch on opercle equals eye, with bright scarlet margin posteriorly, pinkish-purple anteriorly below, and olive-purple above. Inside of gill-opening pale translucent coppery. A dusky blackish-streak between each dorsal and caudal ray basally, and parallel with rays. Anal dusky-gamboge. Caudal mottled basally, and with a coppery tint. Pectoral dilute amber-brown. Ventral same, bright basally,

and membrane with a few dusky spots. Spine and edge of first ventral ray tinted pinkish. Adult. Cedar Swamp Creek tide-water at Petersburg, Cape May County. April 16th, 1906. T. D. Keim and H. W. Fowler. These fish were abundant, and many large examples are taken by the gill-net fishermen. They all agree in their apparent uniformity of color. Color in life of young altogether more bluish than Delaware River specimens. Back pale olive-brown, vertical bands not very distinct. Side of head brownish-emerald and blue. Muzzle translucent brownish. Iris with pearly reflections. Peritoneum showing through coppery-white. Trunk with more purplish reflections. Opercular spot very narrowly blackish. Fins pale translucent. Ventrals most so. Dorsal spines a trifle dusky. Length 2 inches. Upper tide-water of Cedar Swamp Creek, at Petersburg. December 31st, 1905. T. D. Keim and H. W. Fowler. We found little examples abundant in the bayous of the creek.

A medium-sized example was taken in Mantua Creek, above Mantua, April 8th, 1906, by S. H. Hamilton and myself. It is said to be abundant in the streams about Dennisville, in Cape May County. Small examples were taken there in September.

***Boleosoma nigrum olmstedii* (Storer).**

Tessellated Darter.

Found in some numbers about sand riffles of Chestnut Branch of Mantua Creek, April 1st, 1906. They were adult, but without evidence of breeding-dress, and were associated with *Notropis analostanus*.

Family SERRANIDÆ.

***Roccus lineatus* (Bloch).**

Rock. Striped Bass.

In a recent issue of *Forest and Stream*, Mr. L. Huht reports 7 examples of from 2 to 4 pounds in weight taken at Shark River

Inlet on November 9th. They were taken on blood-worm bait, which appears rather unusual for this time of year.

Large examples are sometimes taken in the Delaware below Trenton, off Delanco, Riverton and Burlington.

Labrax lineatus Gill, An. Rep. Smiths Inst., 1856, p. 255.

Morone americana (Gmelin).

White Perch.

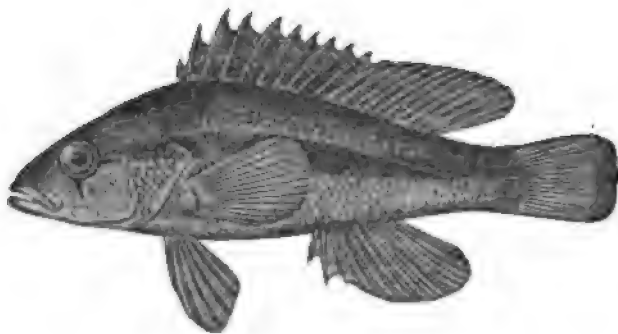
Head $2\frac{3}{4}$; depth $2\frac{1}{2}$; D. IX, 1, 12, 1; A. III, 9, 1; scales 47 in lateral line to base of caudal, and 6 more on latter; 7 scales in vertical series between origin of spinous dorsal and lateral line; 10 scales in a vertical series between origin of spinous anal and lateral line; mandible $2\frac{1}{5}$ in head; fourth dorsal spine $1\frac{7}{8}$; first dorsal ray 2; third anal spine $2\frac{1}{2}$; first anal ray 2; least depth of caudal peduncle $2\frac{3}{4}$; upper caudal lobe $1\frac{1}{3}$; pectoral $1\frac{3}{5}$; ventral $1\frac{2}{3}$; snout 4 in head measured from tip of upper jaw; eye $4\frac{4}{5}$; maxillary 3. Body compressed, rather deep, back elevated, and greatest depth at origin of spinous dorsal. Head compressed, profiles more or less similar, and above upper becomes strongly convex after occiput. Snout conic, and its length $\frac{3}{5}$ its width. Eye rounded, near first third in head. Mouth oblique, and mandible protruding a little. Lips fleshy. Teeth fine, in narrow bands in jaws and on vomer and palatines. Tongue with a narrow band of fine teeth on each side, rounded in front and free. Maxillary reaches first third of eye or a little behind front rim of pupil, and its distal expansion 2 in orbit. Nostrils placed in last third of length of snout. Interorbital space convex and broad. Ridge of opercle salient. Margin of preopercle finely serrate, and serræ rather sparse. Opercular spines 2, lower larger and posterior. Gill-rakers 8 + 12, lanceolate, equal filaments or about 2 in iris. Scales large, finely ctenoid, and in series parallel with lateral line above its course, below in horizontal series. Small scales on bases of fins. Scales in 8 series on cheek. Tubes simple in lateral line, which is concurrent with dorsal profile. Origin of spinous dorsal about midway between front rim of pupil and origin of rayed dorsal. Second and third anal spines subequal, and first $2\frac{1}{2}$ in second. Rayed anal with anterior rays longest. Caudal emarginate, and

upper lobe longer. Pectoral $1\frac{1}{2}$ in space to spinous anal. Ventral inserted behind base of pectoral, reaching $1\frac{1}{2}$ in space to origin of spinous anal. Vent nearer anal than tip of ventral. Color in alcohol largely with silvery reflections, back dull olivaceous, fading paler below, and under surface becoming whitish. Fins brownish, pectoral and ventral paler. Iris slaty. Length 8 inches. Cedar Swamp Creek in tide-water at Petersburg, Cape May County. April 16th, 1906. T. D. Keim and H. W. Fowler.

Color of the above in life largely dull olivaceous-brown above, inclining to dusky over most all of upper surface. Belly and abdomen silvery-white. Sides of head with brassy, and this shade very slightly extending over whole of trunk above. Iris brassy. Inside of gill-opening whitish with coppery reflections. Opercle tinted green. Mandible pale purplish, tinted with pale dusky spots, jaws otherwise pale translucent whitish. Dorsal and caudal olivaceous-brownish. Anal pale. Pectoral brownish, tinted warm basally, and upper edge a little dusky.

This fish is taken about Cape May, Tuckahoe and other places in some numbers at times. At Petersburg they were usually found in gill-nets. Mr. G. Z. Hartman reports 1 from off Palermo, Cape May County, of about $2\frac{1}{2}$ pounds weight. Many varieties are known by their colors, and several of each are usually taken in one haul, according to some fishermen.

Centropristis striatus (Linnæus).



Black Sea Bass. *Centropristis striatus* (Linnæus). (Young.)

Black Sea Bass.

Eudulus auriga (Cuvier).

PLATE 103.

Coachman.

Family LUTIANIDÆ.

Lutianus griseus (Linnæus).

PLATE 104.

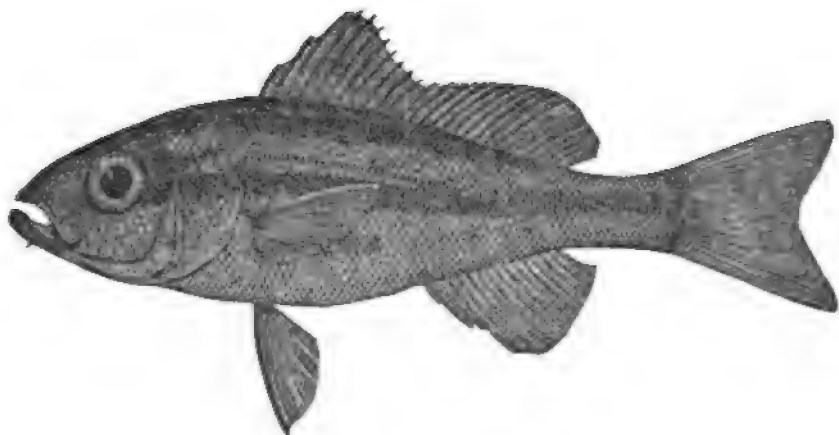
Gray Snapper. Snapper.

Mr. G. Z. Hartman reports 1 from a pound near Palermo, Cape May County, weighing a little over 2 pounds, during the fall of 1902.

Family HÆMULIDÆ.

Orthopristis chrysopterus (Linnæus).

Speckled Red Mouth.



Speckled Red Mouth. *Orthopristis chrysopterus* (Linnæus). (Young.)

Head 3; depth $2\frac{4}{7}$; D. XII, 16, 1; A. III, 13, 1; scales about 60 in lateral line to base of caudal, and about 20? more on latter; 12 scales in a vertical series between origin of spinous dorsal and lateral line; 20 scales in a vertical series between origin of spinous anal and lateral line; snout $2\frac{2}{5}$ in head; eye 4; maxillary $3\frac{1}{2}$;

interorbital space $4\frac{1}{8}$; fourth dorsal spine $2\frac{1}{2}$; fourth dorsal ray $2\frac{1}{4}$; second anal spine $3\frac{1}{2}$; third anal ray $2\frac{1}{3}$; upper caudal lobe $1\frac{1}{4}$; least depth of caudal peduncle 3; pectoral $1\frac{2}{3}$; ventral $1\frac{2}{3}$. Body compressed, predorsal region with median keel and other edges rounded. Profiles similar, back not elevated, and greatest depth falling about base of fifth dorsal spine. Caudal peduncle compressed, a trifle longer than deep. Head compressed, and profiles similar, or upper a little more inclined than lower. Snout a trifle longer than broad. Eye a trifle longer than deep, rounded, high, and about midway in head. Mouth small, terminal and a little inclined. Jaws about even, when closed. Maxillary small, well concealed above by preorbital, reaching front nostril, and its expansion equals vertical diameter of pupil, which is a little less than horizontal. Lips rather thin. Rami of mandible not elevated in jaws. Teeth in jaws minute, in narrow bands. No vomerine, palatine or lingual teeth. Tongue small, rather far back, short, rounded, fleshy and free. Nostrils separated, and close to front of eye. Entire margin of preopercle with weak and rather sparse serræ. Edges of subopercle, interopercle, opercle and preorbital entire. Gill-opening extends forwards opposite posterior margin of pupil. Gill-rakers 8+12, lanceolate, weak, and longest about $\frac{4}{5}$ of filaments, which are about same of orbit horizontally. Isthmus rather broad and rounded. Scales moderately small, largest on costal region, and above lateral line in oblique series sloping to bases of dorsals. On caudal peduncle, both above and below in horizontal series similar to those on costal region and abdomen generally. Head, except lips and maxillary, more or less completely covered with small scales, in about 17 series on cheek. Suprascapula covered with small scales. Dorsals and anals without scales, except narrow basal sheaths extending nearly their entire lengths. Greater portion of caudal, except posterior margin, covered with fine scales. Pectoral scaly at base. Ventral with a pointed scaly axillary keel $3\frac{1}{2}$ in appressed fin. Scales on chest and prepectoral region minute. Lateral line of simple tubes concurrent with dorsal profile and extending well out on caudal basally. Origin of spinous dorsal falling about midway in vertical between tip of snout and base of last spine, spines

slender, graduated down from fourth, which is longest, and margin of fin apparently entire. Rayed dorsal inserted a little nearer origin of spinous fin than base of caudal, anterior rays a little higher and margin of fin rounded. Spinous anal inserted about midway between origin of pectoral and base of caudal, spines slender and second barely shorter than third. Rayed anal similar to rayed dorsal. Caudal emarginate and apparently upper lobe a little longer. Pectoral inserted opposite origin of dorsal, and reaching $\frac{3}{4}$ to spinous anal. Ventral inserted behind origin of pectoral and reaching $\frac{3}{4}$ of space to spinous anal. Vent midway between tip of ventral and origin of spinous anal. Color in life beautiful dark steel lavender-brown on back and upper surface generally, this color fading into pale lavender-gray on sides, cheek, opercle, and a large extent of lateral region. Under surface of head with dilute lavender tints. Chest and breast whitish, bounded just above with a dilute greenish-olive tinge extending from below pectoral over an area to lower lobe of caudal basally, and all more or less finely punctate with dusky dots, or with soiled appearance. This shade of dark color more intense on back with same effect. Top of head dusky. Beautiful gilded orange streaks longitudinally, none wider than pupil, distributed over trunk above, and on sides and same region of head. These are rather irregular, sometimes vermiculated, and are slightly inclined up posteriorly from front of lateral line on back anteriorly, though posteriorly they simply cross over. Here they are also more narrow, following well in courses of scales and running into a line extending from occiput along back close and concurrent with dorsal profile. Just above another almost at profile line, and both extend back to caudal peduncle. On costal region lines all broken up into small gilded dots. On side of caudal peduncle lines resolve themselves into 5 bands and extend out more or less broken on base of caudal. Spinous dorsal beautiful dilute dusky or lavender-gray, marked with a number of large blotches of gilded-brownish, most distinct and more or less serial along base of fin. Edge of spinous dorsal not especially dark, though broadly darker than rest. Rayed dorsal, caudal and anal beautiful deep greenish-olive, becoming diluted grayish-dusky marginally. Outer portion

of rayed dorsal from a point sloping down from tip of first ray, till nearly to bottom of last, broadly dusky-olivaceous, and this area well and sharply defined, leaving a narrow pale base. Rayed dorsal rather numerously spotted with gilded-brown, spots more or less equal and most conspicuous at base of fin. Caudal and anal brighter green at basal regions. Edge of spinous anal also dusky, though base pale. Pectoral pale translucent grayish, mostly of uniform tint. Ventral grayish around edges of fins, becoming dull yellowish in middle, and whitish basally. When appressed front edge whitish, and outer portion slightly dusky. Iris silvery-white, with a bright vermilion speck on upper outer edge. Jaws and lips translucent grayish. Inside of mouth pale orange-red. Length 5 inches. Palermo, Cape May County. October 10th, 1906.

This is the only New Jersey example I have seen. It was sent to me by Mr. G. Z. Hartman.

Orthopristis chrysopterus Fowler, Science, XXIV, 1906, November 9th, p. 596.

Family SPARIDÆ.

Lagodon rhomboides (Linnæus).

Sailor's Choice.

This is known to me from an example taken about a wreck near Cape May some years ago, and reported by Mr. H. W. Hand.

Lagodon rhomboides Fowler, Science XXIV, 1906, November 9th, p. 596.

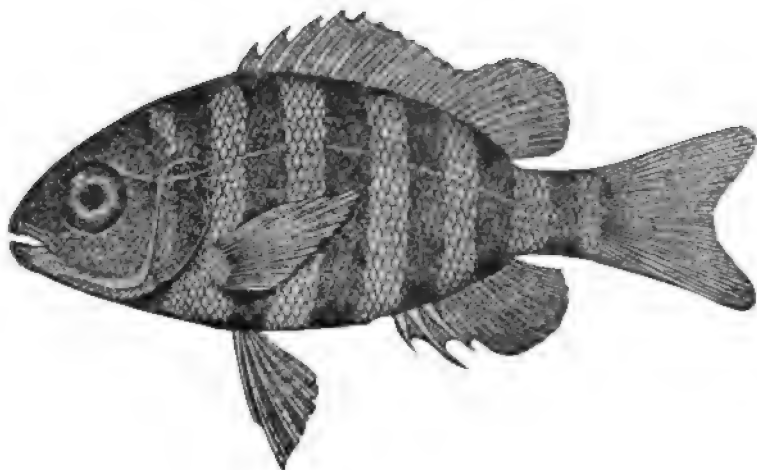
Archosargus probatocephalus (Walbaum).

Sheep's Head.

At Palermo in Cape May County, Mr. G. Z. Hartman says this is a common fish, the season being between May and October

in warm weather, though they run best from the last of August till the middle of September. The bait used is hermit-crab, razor-clam or ordinary clam, and spotted, sand and fiddler crabs.

Sargis ovis Norris, Am. Angler, 1868, p. 279, fig.



Sheep's Head. *Archosargus probatocephalus* (Walbaum). (Young.)

Family GERRIDÆ.

Eucinostomus gula (Cuvier).

PLATE 105.

Mojarrita.

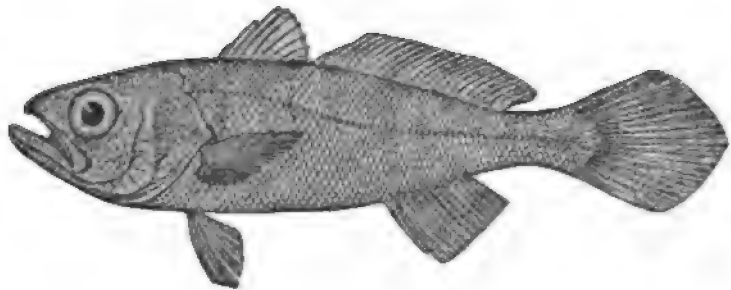
Family SCIÆNIDÆ.

Cynoscion regalis (Schneider).

Weak Fish.

At Sea Isle City a number were taken daily at times in July, according to Mr. Fox. About Cape May many are caught in the

sound, and during the past season they have been especially abundant. They have been reported from the Tuckahoe River as far as tide water.



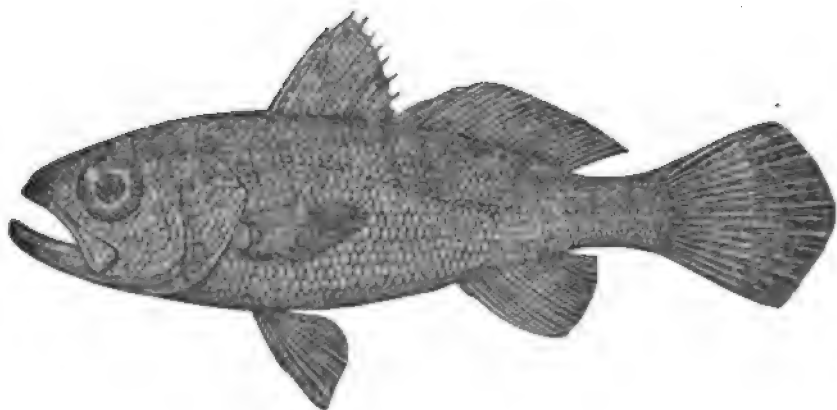
Weak Fish. *Cynoscion regalis* (Schneider). (Young.)

***Bairdiella chrysura* (Lacépède).**

Silver Perch. White Perch.

Head $3\frac{1}{8}$; depth $3\frac{1}{4}$; D. XI, 1, 21, 1; A. II, 9, 1; scales 98 in lateral line to base of caudal and 5 more on latter; tubes 54 in lateral line to base of caudal and 5 more on latter; 8 scales in a vertical series between origin of spinous dorsal and lateral line; 10 scales in a vertical series between origin of spinous anal and lateral line; snout 4 in head; eye $4\frac{1}{3}$; maxillary $2\frac{2}{5}$; inter-orbital space $4\frac{1}{2}$; fourth dorsal spine $1\frac{3}{5}$; fourth dorsal ray 2; second anal spine $2\frac{1}{15}$; first anal ray $1\frac{9}{10}$; least depth of caudal peduncle $2\frac{3}{5}$; caudal, measured to tips of median rays, $1\frac{2}{5}$; pectoral $1\frac{3}{5}$; ventral $1\frac{1}{2}$. Body elongate, compressed, back a little elevated, greatest depth at origin of spinous fin, and upper profile a little more convex than lower. Head compressed, and upper profile a little concave from snout to occiput. Snout convex both in profile and over surface, and its length $1\frac{1}{3}$ in its breadth. Eye rounded, near first third in head. Mouth oblique, and jaws about even. Maxillary oblique, its upper moiety concealed by preorbital, reaching middle of orbit, and its distal expanded extremity $1\frac{1}{2}$ in orbit. Teeth small, upper biserial, with outer series a little enlarged, curved and rather sparse, and mandibular a little large, uniserial. No other teeth. Tongue

broad, rounded, and free. Nostrils close together in front of eye, posterior larger. Preopercular angle rather salient, with spine directed down, and posterior margin serrated, serræ increasing in size towards angle. Obsolete opercular spines 2. Margin of suprascapula entire. Gill-rakers 11+15, 11, lanceolate, and longest a little longer than filaments or $1\frac{3}{5}$ in eye. Scales ctenoid, largest on side and opercle, above lateral line at first in series sloping obliquely up towards base of spinous dorsal, and after this point in series longitudinally parallel. Below lateral line scales in horizontal series, posteriorly parallel with its course. Series of small scales 1 or 2 along bases of rayed dorsal and anal, conspicuous. Base of caudal finely scaled. About 13



Silver Perch. *Bairdiella chrysura* (Lacépède). (Young.)

series of scales on cheek. Lateral line of simple tubes, a little convex at first, then sloping down to middle of side of caudal peduncle, and continued out on base of caudal. Spinous dorsal inserted about midway between posterior nostrils and origin of rayed dorsal, and graduated down from fourth or longest spine, fifth subequal, and last spines short. Rayed dorsal inserted midway between posterior margin of preopercle and base of caudal, and rays graduated down from first which is highest. Spinous anal inserted nearly midway between tip of pectoral and base of caudal, second spine much longer, and slender. Rayed anal graduated down from first ray, which is longest. Caudal broad, with upper and median rays longest so that posterior edges are

concave, convex and then concave. Pectoral slender, upper rays longest, and reaching not quite half way to spinous anal. Ventral inserted behind base of pectoral, reaches half way to spinous anal, and spine $1\frac{2}{3}$ in fin. Vent close in front of spinous anal. Color in alcohol scarcely faded from that as noted below. Color when fresh generally dull lavender-grayish on back and upper surface, sides and lower surface becoming dull whitish. Entire body with a more or less bright silvery sheen. Upper surface in some lights reflecting brownish. Jaws more or less silvery, upper brownish, and lips specked with dull dusky. Iris bright silvery. Spinous dorsal grayish-dusky, a little paler basally, and spines burnished with silvery. Rayed dorsal and caudal dull brownish-gray. Anal and ventral pale yellowish, becoming whitish towards ends. Pectoral translucent pale brownish, paler below. Inside of gill-opening silvery, speckled with brownish above. Length $8\frac{1}{4}$ inches. Sea Isle City. Wm. J. Fox.

Mr. Fox saw several young about 4 inches long, September 30th, 1906, also a number of small examples of *Pogonias*, in the thoroughfare at Sea Isle City. This fish takes the hook with a rush and is considered a desirable game-fish.

Bairdiella chrysura Fowler, Science, XXIV, 1906, November 9th, p. 596.

***Sciaenops ocellatus* (Linnæus).**

Channel Bass.

Mr. Fox says that 5 were taken at Townsend's Inlet, July 15th, 1906. The dark spot at the base of the tail varies somewhat, according to the fishermen.

***Leiostomus xanthurus* Lacépède.**

Cape May Goody.

Leiostomus obliquus Norris, Am. Angler, 1869, p. 290. fig.

Genus MICROPOGON Cuvier.

The Croakers.

***Micropogon undulatus* (Linnæus).**

PLATE 106.

Croaker.

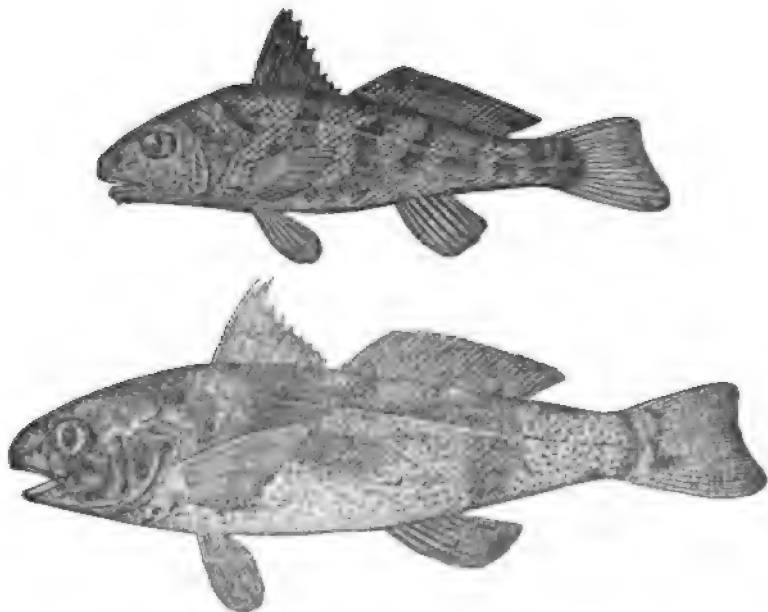
Distinguished from the next chiefly by several small barbels along the sides of the lower jaw.

Mr. Wm. J. Fox found this fish abundant off Sea Isle City, during the summer of 1906. This fish I have also noted at Stone Harbor, Cape May, Anglesea, Grassy Sound, Avalon, Ocean City, Atlantic City and Barnegat Pier. It reaches a length of 1 foot and is a good food-fish. In the "Fishes of New Jersey" I overlooked this species. At present I have no New Jersey examples.

Micropogon undulatus Abbott, Geol. N. J., 1868, p. 811.

***Menticirrhus saxatilis* (Schneider).**

King Fish.



King Fish. *Menticirrhus saxatilis* (Schneider). (Young.)

Mr. S. R. Morse showed me an example in the State Museum, at Trenton, $15\frac{3}{16}$ inches in length. It was taken off Long Branch according to him, during the early part of 1903. Eye

$2\frac{1}{3}$ in snout and first dorsal spine reaching a little beyond origin of dorsal radii. Very young abundant in the surf at Stone Harbor, July 25th, 1906.

Umbrina nebulosa Norris, Am. Angler, 1869, p. 286, fig.

***Pogonias cromis* (Linnæus).**

Banded Drum. Black Drum.

Head $3\frac{1}{8}$; depth $2\frac{3}{5}$; D. X, I, 23, 1; A. II, 6; scales 51 in lateral line to base of caudal and 5 more on latter; 6 scales in a vertical series between origin of rayed dorsal and lateral line in a vertical series; 12 scales in a vertical series between origin of spinous anal and lateral line; snout $3\frac{1}{8}$ in head; eye $4\frac{2}{5}$; maxillary 3; interorbital space $4\frac{1}{5}$; second dorsal spine $1\frac{7}{8}$; first dorsal ray $2\frac{1}{4}$; second anal spine $1\frac{3}{4}$; first anal ray $1\frac{3}{5}$; caudal $1\frac{1}{4}$; least depth of caudal peduncle $2\frac{2}{3}$; pectoral $1\frac{1}{6}$; ventral $1\frac{3}{5}$. Body compressed, deep, back elevated so that upper profile is ovoid with greatest bulge at origin of dorsal. Predorsal region keeled, belly and chest flattened. Caudal peduncle compressed, and its length about $\frac{4}{5}$ its least depth. Head compressed, and upper profile steeper than lower, and evenly convex to origin of spinous dorsal. Snout as broad as long, obtuse, projecting beyond edge of upper jaw. Eye not high, a little longer than deep, and near first third in head. Mouth little inclined, inferior, both jaws inferior, and lower a little posterior to upper. Maxillary well concealed above, reaching front margin of pupil, and its expansion about half of eye horizontally. Lips a little fleshy. Small short cirri, about 15 in number, along inner margin of mandible externally. Exposed inferior surface of mandible largely porous. Rather broad bands of fine teeth in jaws. Tongue large, thick, rounded and little free. Nostrils close in front of eye, posterior much larger. Interorbital space broad, and nearly perfectly flat. Margins of preorbital and preopercle entire. Gill-opening forward to anterior margin of pupil. Gill-rakers 5 + 13, short, pointed, and longest about half of filaments, which are about $\frac{2}{3}$ of eye horizontally. Isthmus a little broad and convex. Scales roughly ctenoid, largest on middle of sides of body, and parallel with lateral line above its course. Below lateral line scales in series also parallel with its course. Lower

costal series of scales convergent with upper series over vent. Lateral line in course parallel with dorsal profile. No scales on dorsals and anals, except along bases, where they are small. Base of caudal covered with small scales. Very small scales on chest and breast. Head more or less scaly, except lips, mandible and maxillary. About 12 series of scales on cheek. Lateral line of more or less simple continuous tubes, and till over vent slightly arborescent. Spinous dorsal inserted midway between tip of snout and origin of rayed fin in vertical, spines graduated down from second which is longest, to ninth, and first shortest. Rayed dorsal preceded by a spine a little shorter than eighth, though longer than ninth and tenth, and rays a little higher anteriorly with straight margin. Spinous anal inserted much nearer base of caudal than that of ventral, first spine very short, and second greatly enlarged and a little undulate. Depressed anal reaching $\frac{3}{4}$ to base of caudal. Caudal rounded. Pectoral with upper rays longest, pointed and reaching about $\frac{2}{3}$ to spinous anal. Ventral inserted behind pectoral, reaches $\frac{3}{5}$ to spinous anal, and spine $\frac{4}{7}$ of fin. Vent a little nearer origin of spinous anal than tip of appressed ventral. Color when fresh steel lavender-gray generally, dark shade due to rather soiled effect of minute dusky dots or points which also extend well down to lower side of body. Head dusky above, its sides, like most of that of trunk, bright silvery in some lights. Under surface of head, chest, abdomen and caudal peduncle, plain whitish. Broad transverse bands 6. First from occiput down upper side of head, second from just before spinous dorsal, third begins about base of fourth dorsal spine, fourth from bases of last few dorsal spines and first few dorsal rays, fifth from middle of base of rayed dorsal, and sixth saddled over caudal peduncle. On back these bands darker and extending up on bases of dorsals. Vertical fins dusky-gray, marginally darker. Pectoral brownish, and pale basally, becoming grayish on outer portion. Ventral largely dusky on outer portion, then grayish, and basally whitish. Lips grayish, and white. Iris dull orange, soiled blackish above and below. Length $6\frac{1}{2}$ inches. Palermo, Cape May County. October 11th, 1906. G. Z. Hartman.

Mr. Hartman had also reported their occurrence to me previously. On one occasion as many as a hundred or more

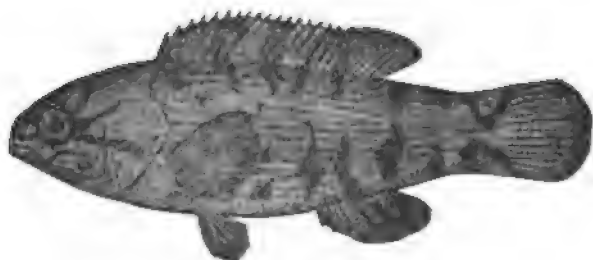
small ones were taken at one time. In October of 1905 5 or 6 were taken. Their flesh was very good as food. They occur in the thoroughfare. Mr. Fox reported several young examples from Ludlam's thoroughfare, Sea Isle City, September 30th, 1906.

Family LABRIDÆ.

Tautoga onitis (Linnæus).

Black Fish. Sea Tog.

Mr. G. Z. Hartman, of Palermo, says in his experience they only bite in winter as a rule during a warm day.



Black Fish. *Tautoga onitis* (Linnæus). (Young.)

Family ILARCHIDÆ.

Chaetodipterus faber (Broussonet).

Angel Fish. Spade Fish. Irish Sheep's Head.

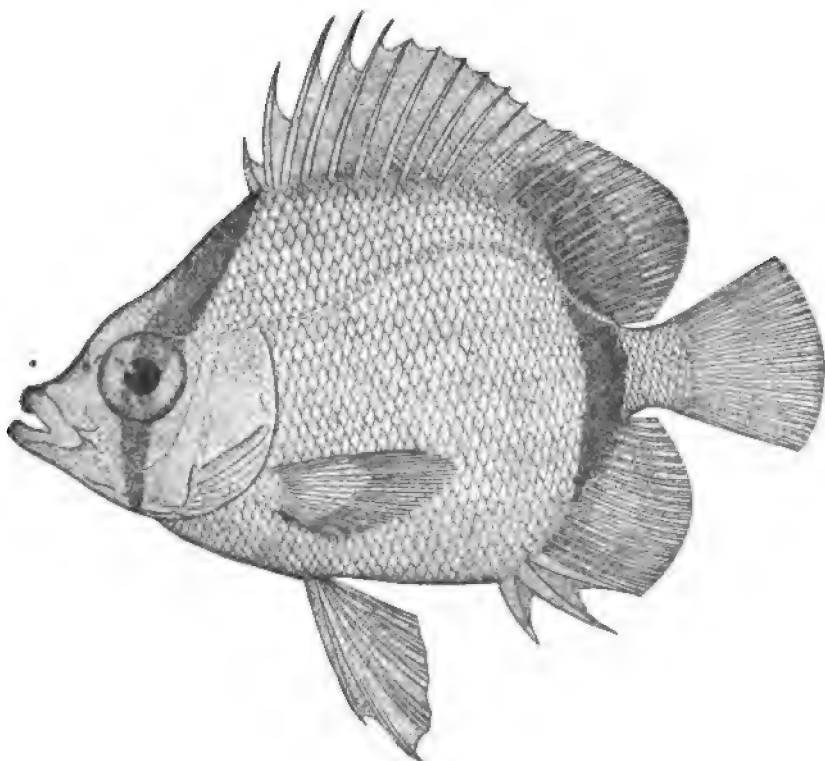
Color when fresh leaden-gray generally, margin of each scale of slightly darker tint. Body, especially above, glossed with metallic dilute greenish, purplish and bluish tints. Trunk with 5 indistinct transverse or vertical bands of darker shade than body-color, first at occipital region down to base of pectoral very broad, second midway between first and front of dorsal and narrower, third from front of dorsal to front of anal, fourth from midway between bases of rayed dorsal and anal, and fifth on caudal peduncle posteriorly. Lower half of body more or less tinted with dull creamy-white, and on abdomen below becoming more or less opaque. Gray color of upper regions descends to level with lower incision of gill-opening, so that line of demarcation slopes up abruptly till about level with lower base of

pectoral. A gray-brown streak narrowly a little inclined back from axil of ventral posteriorly, and fading out below second transverse dark band. Snout a little dusky above. Lips pale creamy-gray. Iris pale brassy. Vertical fins grayish-dusky on outer portions, basally pale with metallic gray. Pectoral dilute grayish, broad margin pale, also sub-bassally some with base itself darker. Ventral creamy at base and on inner rays, spine and distally dusky to blackish. Edge of gill-opening, next to opercle, silvery-gray. Inside gill-opening same. Length 15 inches. Three examples, this the smallest, taken at Sea Isle City. July 11th, 1906. Wm. J. Fox.

Family CHÆTODONTIDÆ.

Chætodon ocellatus Bloch.

Ocellated Butterfly Fish.



Ocellated Butterfly Fish. *Chætodon ocellatus* Bloch.

Chaetodon striatus Linnæus.

PLATE 107.

Streaked Butterfly Fish.

Pomacanthus arcuatus (Linnæus).

Black Angel Fish.

On July 1st, 1906, Mr. Wm. J. Fox reported 3 large examples of this species taken by the fishermen of Sea Isle City. Several others have been taken during the season, possibly in all a half-dozen. As the fishermen prize them for food, usually making them into a sort of chowder, they seldom come into the markets. They also believe they are as abundant as the spade fish, *Chaetodipterus*.

Pomacanthus arcuatus Fowler, Science, XXIV, 1906, November 9th, p. 596.

Angelichthys ciliaris (Linnæus).

PLATE 108.

Blue Angel Fish. Angel Fish.

Family TEUTHIDIDÆ.

The Surgeon Fishes.

Genus TEUTHIS Linnæus.

The Doctor Fishes.

Teuthis hepatus Linnæus.

PLATE 109.

As the first species mentioned by Linnæus for this genus is the present one, it must be retained in place of *Harpurus*, published in 1788.

Family BALISTIDÆ.

Balistes carolinensis Gmelin.

Trigger Fish.

Head 3; depth $1\frac{7}{8}$; D. III-II, 22; A. III, 22, 1; scales about 55 counted from upper edge of gill-opening to base of caudal, and 5 more on latter; 35 scales in transverse series between origin of rayed dorsal and that of anal; snout $1\frac{1}{3}$ in head; eye $5\frac{2}{3}$; maxillary 5; interorbital space $3\frac{1}{4}$; first dorsal spine $2\frac{1}{10}$; second branched dorsal ray $1\frac{4}{5}$; first branched anal ray $1\frac{9}{10}$; least depth of caudal peduncle 4; lower caudal lobe $1\frac{1}{3}$; pectoral $2\frac{1}{2}$. Body compressed, deep, rather ellipsoid, with similar convex profiles, and greatest depth falling about pubic process. Edges of body rounded. Head large, compressed, lower profile a little more convex than upper, which is slightly depressed before eye. Eye rounded, a trifle longer than deep, high. Mouth small, almost horizontal. Lips fleshy, teeth uniserial, large, and anterior pair in each jaw largest, others all graduated back as smaller with notched edges. Interorbital space highly and evenly convex. An oblique groove extending down from front of eye, and above this a slight parallel depression containing nostrils, which are close together, similar, and posterior about half an eye-diameter in front of eye. Gill-opening a slightly oblique vertical slit equal to about $1\frac{1}{2}$ eye-diameters, placed well behind orbit, and its lower edge before and below origin of pectoral. Scales all rough, largest and forming horizontal oblique series just below pectoral. About 25 scales between maxillary and gill-opening. Small scales along bases of rayed vertical fins. Lateral line inconspicuous, crooked and undulating. It extends from eye back convexly, ascending close to interdorsal space, then bends suddenly down nearly opposite antero-median basal region of anal to ascend again after forming a V-shaped angle and continue along middle of side of caudal peduncle. After interdorsal region tubes exceptionally obsolete. Spinous dorsal with its origin close behind eye, first spine largest, robust, and anterior face asperous, others graduated down. Rayed anal graduated

down from first and second branched rays which are highest part of fin, and its origin a little nearer anterior nostril than base of caudal. Rayed anal inserted behind origin of rayed dorsal, which it resembles, or about midway between front of eye and base of caudal. Caudal broad, emarginate, and upper and lower rays ending in slightly produced points. Pectoral rounded, upper rays longest. Pubic process robust, movable, spinescent, and followed by about 8 short more or less imbedded spines. Vent large, close in front of anal. Color in alcohol faded more brownish than noted below. Color when fresh in formalin smutty-brown generally, fading into a dully brownish-white on lower surface, and interstices between scales all more or less livid or with a plumbeous tinge, above median line as progressing dorsally becoming more deeper or dull bluish colored, and as progressing ventrally becoming more pale or plumbeous-white. Spinous dorsal pale brown spotted or vermiculated with pale blue. Rayed dorsal, anal and caudal vermiculated and spotted with azure-blue inclining more or less to french-blue and cobalt-blue tints on darker or deep parts of fins, such as anterior portion of former and outer or broad marginal portions of two latter. These fins all with more or less dusky tints on outer portions, ground-color somewhat olivaceous-brownish. In fact entire back with more or less deep azure tints reflected here and there. Pectoral brownish tinted with pale bluish basally. Base of pectoral with brownish blotches marked by pale reticulating bluish lines. Lips brownish, upper a little dark, and lower pale translucent. A bright narrow milky-white line across chin from lower corners of mouth. Iris glassy-silvery with exposed ball above blackish and bluish. Length 11 inches. Sea Isle City. August 30th, 1906. Wm. J. Fox. Also 2 others taken the same day in the pounds with several large examples of *Vomer setapinnis*.

Balistes carolinensis Fowler, Science, XXIV, 1906, November 9th, p. 596.

Family MONACANTHIDÆ.

Stephanolepis hispidus (Linnæus).

File Fish.

Head $3\frac{1}{8}$; depth $1\frac{1}{8}$; D. II-33; A. 32; snout $1\frac{2}{7}$ in head; eye $3\frac{7}{8}$; interorbital space $3\frac{1}{5}$; first dorsal spine $1\frac{1}{3}$; sixth dorsal ray $1\frac{5}{6}$; sixth anal ray $2\frac{1}{3}$; least depth of caudal peduncle $2\frac{3}{4}$; caudal 1; pectoral 2. Body orbicular, greatly compressed, and its greatest width about $4\frac{1}{2}$ in its greatest depth which is at origin of rayed dorsal. Lower profile evenly convex from below mandible to end of pubic process. Upper profile forming an anterior obtuse angle at origin of spinous dorsal, angle at origin of spinous dorsal and another higher at origin of rayed dorsal. Profile along bases of rayed dorsal and anal a little convex and rapidly descending posteriorly to constricted caudal peduncle. Edges of body more or less rounded. Caudal peduncle well compressed and as long as deep. Head long, with well inclined anterior profile which is undulated so that snout is convex. Width of snout about $1\frac{1}{2}$ in its length. Eye circular, high, and falling just before gill-opening. Mouth small. Jaws even and teeth large, increasing anteriorly, and their edges notched. Lips fleshy. Nostrils small, separated, and close to eye in front on each side of snout. Interorbital space convex with occipital keel rising abruptly behind. Gill-opening obliquely before base of pectoral above, distant from its upper point space equal to eye, and its length about same. Body finely roughened, tubercles larger on head and about pubic flap, very fine on caudal peduncle and fin-rays. Spinous dorsal inserted about over last $\frac{3}{5}$ of eye, first spine robust, more or less straight and with about 6 large antrorse spines along each side. Second dorsal spine small and concealed in membrane. Rayed dorsal falls nearer base of caudal than tip of snout and antero-median rays highest. Anal falling a little behind origin of rayed dorsal, and postero-median rays longest. Caudal long, with robust rays, and rounded. Origin of pectoral a little above in middle of depth of body, and falling

a little nearer origin of anal than tip of snout. Appressed ventral $1\frac{3}{4}$ in space to origin of anal. Pubic process small and movable, flap behind asperous, but not produced. Vent close in front of anal. Color when fresh sepia-brown generally, and more or less uniformly. Here and there on sides paler blotches. Lips pale brownish and teeth whitish. Iris dull brownish-yellow. Dorsal, anal and caudal pale or hyaline greenish-brown. Caudal with 2 obscure broad ill-defined transverse bands. Pectoral whitish. Length 5 inches. Palermo, Cape May County. October 10th, 1906. G. Z. Hartman.

Also another with same data. Neither have first dorsal ray filamentous.

Stephanolepis hispidus Fowler, Science, XXIV, 1906, November 9th, p. 596.

Alutera schoepfli (Walbaum).

Leather Jacket.

Color when fresh, back gray-brown with more or less soiled effect, and blotched or spotted rather indistinctly with soiled or gilded ochraceous-golden. These spots all more or less smaller than pupil, and not extending below gill-opening in any definite form as color all below is more or less entirely golden-ochraceous. Iris dull glassy-olivaceous, more pale or whitish about pupil. Vertical fins pale gray-brown, paler basally on dorsal and anal. Pectoral pale grayish-white, radii distally scarcely brownish. Ventral margin of body pale and more or less whitish. Lips whitish, and chin with a plumbeous shade in front. Upper anterior surface of head more or less pale with a dark brownish speckled streak extending forward from front of eye above. Length 16 inches. Sea Isle City. June 24th, 1906. Wm. J. Fox. Another about same size was altogether more uniform gray-brown with very indistinct gilded spots on back, and lower surface without golden shade. Mr. Wm. J. Fox found this fish abundant about Sea Isle City during the summer of 1906, and many examples were taken in the deep-sea pounds. He also noted it in the summer of 1905 at this locality.

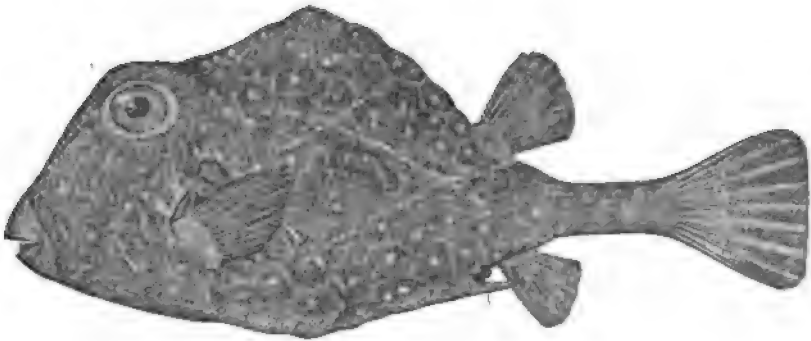
I have received 3 small examples, the largest of which is $10\frac{1}{4}$ inches, from Palermo, Cape May County, collected by Mr. G. Z. Hartman, October 10th, 1906. They are interesting as showing the comparatively long caudal, and in the longest is $2\frac{4}{7}$ in the head and trunk. They were the usual sandy color when fresh, and spotted or blotched more or less with dull gilt-chrome over most of the side.

Alutera schæpfii Fowler, Science, XXIV, 1906, November 9th, p. 596.

Family OSTRACIIDÆ.

Lactophrys trigonus (Linnæus).

Trunk Fish.



Trunk Fish. *Lactophrys trigonus* (Linnæus).

Family TETRODONTIDÆ.

***Spheroides maculatus* (Schneider).**

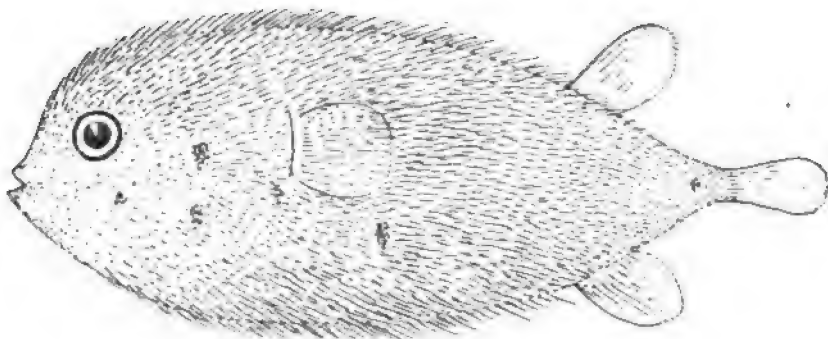
Puffer.

A few were obtained at Sea Isle City during the past summer by Mr. Wm. J. Fox.

Family DIODONTIDÆ.

***Trichodiodon pilosus* (Mitchill).**

Hairy Box Fish.



Hairy Box Fish. *Trichodiodon pilosus* (Mitchill).

Family MOLIDÆ.

***Mola mola* (Linnæus).**

Head Fish. Cow Fish.

Mr. Fox reports 3 taken in the pounds at Sea Isle City during this season, one in June and the others late in July. One was reported early in July from Wildwood.

Family COTTIDÆ.

***Uranidea gracilis* (Heckel).**

PLATE 110.

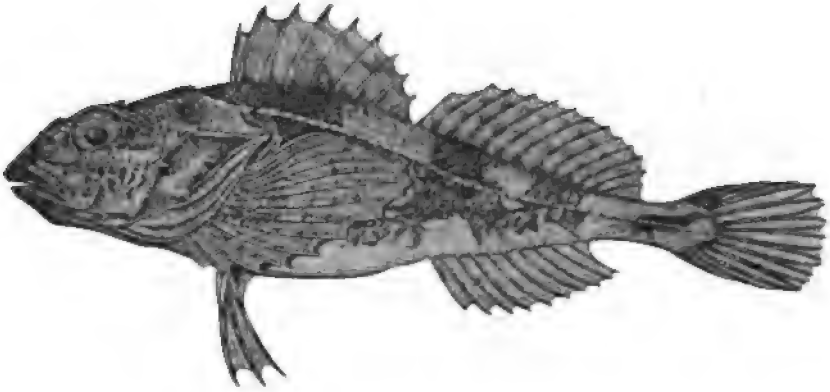
Miller's Thumb. Star Gazer.

I have since examined many examples from neighboring localities and believe them all to be this species.

? *Cottus meridionalis* Cope, Proc. Acad. Nat. Sci. Phila., 1865, p. 82.

***Myoxocephalus æneus* (Mitchill).**

Sculpin.



Sculpin. *Myoxocephalus æneus* (Mitchill).

Family TRIGLIDÆ.

***Prionotus evolans strigatus* (Cuvier).**

Flier.

Color when fresh faded gray-brown above and opaque-white below. Sides of head and body with orange and ruddy tints, former especially bright around lips. Ventrals and anal pinkish. Caudal gray with saffron or yellowish tint, margin milky-plumbeous posteriorly. Spinous dorsal gray-brown, blackish blotch along edge near tips of third to fifth spines. Rayed dorsal gray-orange. Pectoral dusky gray-brown, with various shades of ruddy-brown and olivaceous and fine cross-lines of deep brown. Specks and dots on fins and body inclining from deep brown to more or less warm tints. Iris golden-brown. Length $11\frac{3}{4}$ inches. Sea Isle City. July 1st, 1906. Wm. J. Fox.

Family GOBIIDÆ.

***Gobiosoma bosci* (Lacépède).**

PLATE III.

Naked Goby.

Family ECHENEIDIDÆ.

Echeneis alba-cauda Mitchill.

Leech.

Mr. G. Z. Hartman of Palermo, in Cape May County, reports it to usually occur on most all sharks of any size. Mr. Fox obtained it at Sea Isle City during the past summer.

Echeneis alba-cauda Fowler, Science, XXIV, 1906, November 9th, p. 596.

Remora remora (Linnæus).

PLATE 112.

Remora.

Family PLEURONECTIDÆ.

Lophopsetta maculata (Mitchill).

Window Pane. Day Light.

Color when fresh, sinistral side dull olivaceous-drab, marked with deeper brown or umber spots all over trunk and on fins, where, however, they become enlarged, elongated and altogether more dark or blackish. Dark spots on trunk apparently smaller along median axis of body. In addition to this sinistral side all finely specked with dull white in between larger dark spots, and these pale spots also extend out on vertical fins where they do not, however, become enlarged. Anterior free rays of dorsal pale. Pectoral transparent brownish, radii spotted with brownish and specked whitish. On dextral side translucent whitish, pectoral same only transparent, and vertical fins becoming more or less grayish towards margins, with dark spots of sinistral side showing through more or less distinctly. Iris specked deep brownish-olive, narrow ring around pupil golden. Length $7\frac{1}{8}$ inches. Sea Isle City. July 15th, 1906. Wm. J. Fox.

Etropus microstomus (Gill).

PLATE 113.

Little Flounder.

Head $4\frac{1}{3}$; depth $2\frac{1}{6}$; D. 83; A. 65; P. 9; V. 6; scales about 40 in lateral line counted from head to base of caudal and 3 more on latter; 12 scales in a vertical series between thirty-third dorsal ray and lateral line; 16 scales between ninth anal ray and lateral line in a vertical series; mandible $2\frac{4}{5}$ in head; thirtieth dorsal ray $2\frac{1}{3}$; twenty-first anal ray $1\frac{4}{5}$; caudal 1; pectoral $1\frac{1}{5}$; ventral $1\frac{9}{10}$; snout 5 in head measured from tip of upper jaw; eye $4\frac{1}{8}$; maxillary $3\frac{2}{3}$; least depth of caudal peduncle $1\frac{3}{4}$. Body strongly compressed, ovoid, with bulge anterior or about first third in total length, and upper profile a little more evenly convex than lower, which has lower margin straight after bulge. Caudal peduncle broad, and strongly compressed. Head well compressed, much deeper than long, edges more or less trenchant and upper with a notch just before eye. Snout a little broader than long, surface somewhat convex. Eyes sinistral, a little elongate, and lower anterior to upper about first sixth of its length. Mouth small, obliquely vertical, and with gape a little curved up in profile. Mandible well protruding. Lips fleshy, though not very thick. Maxillary curved, its posterior margin encroaching on lower anterior margin of eye, and its distal expansion about a third of horizontal diameter of latter. Teeth small, in small bands, and close together in jaws, those in front a little enlarged. Nasal area rhombic, and nostrils separated and about level with bony interorbital keel, which separates eyes. Dextral nostrils close to indenture of upper profile and similarly separated. Lower edge of preopercle entire. Gill-opening extending forward about opposite posterior margin of upper pupil. Gill-rakers about 5 short weak tubercles and much shorter than filaments, which are about $\frac{2}{3}$ of upper eye horizontally. Isthmus narrow, surface presenting a narrow flattened triangle. Shoulder-girdle encroaches in isthmian cavity as deep trenchant or rudder-like process with slightly produced point. Scales on left

side of body large, with slightly roughened edges, more or less smooth over surface, at base of each in exposed sockets a number of small ones of irregular size, all more or less with obtusely triangular edges, and disposed in series parallel with lateral line. Scales on left side anterior to its greatest depth all smaller than elsewhere. Scales on cheek in about 14 series and all of head covered with more or less small scales, except lips and internasal area. Scales on right side with edges more rounded, with small scales about their bases though not especially reduced on anterior half of body. Scales on head large, mostly without small scales at bases, and about 8 series on cheek. Base of caudal with small scales. Lateral line very slightly convex at first till about opposite end of pectoral, then perfectly straight to base of caudal. Dorsal begins opposite space between dextral pair of nostrils, rises to its greatest height about greatest depth of body, and slopes very gradually down to last rays which are graduated shorter more abruptly. Anal begins about opposite origin of pectoral, rises for about $\frac{3}{5}$ its length, or just after greatest depth of body, and then graduated like dorsal. Anterior rays of both dorsal and anal with distal portions largely free, membranes gradually encroaching on fins to their greatest height after which tips are not free. Caudal rather broadly rounded. Right pectoral short, a trifle more than half of head, and upper rays longest. Left pectoral similar, only larger. Ventrals separate, right a little anterior and larger, and when appressed reaching base of third anal ray. Vent forming a pore just after base of right ventral on right side. Color in alcohol on right side brownish-white, vertical fins grayish, and a little deeper basally. Pectoral whitish. Left side gray-brown, with a warm shade, and minutely mottled or speckled with grayish and pale dusky. Lateral line in a slightly more brownish streak than general body-color. Fins all grayish-brown, deeper basally, and all mottled obscurely with shades of same but darker. Iris slaty. Length $4\frac{5}{16}$ inches. Ocean City.

I am indebted to the United States National Museum for the opportunity of examining this example. It is now in the collection of the Academy.

***Paralichthys dentatus* (Linnæus).**

Summer Flounder.

Abundant at Sea Isle City during the past summer. According to Mr. Wm. J. Fox as many as a hundred have been taken on lines during a single day.

***Limanda ferruginea* (Storer).**

Mud Dab. Hooked Snout Flounder.

This has been taken at Cape May according to Mr. H. W. Hand.

Limanda ferruginea Fowler, Science, XXIV, 1906, November 9th, p. 596.

Family ASTROSCOPIDÆ.***Astroscopus guttatus* (Abbott).**

PLATE 114.

Northern Star Gazer. Spotted Star Gazer.

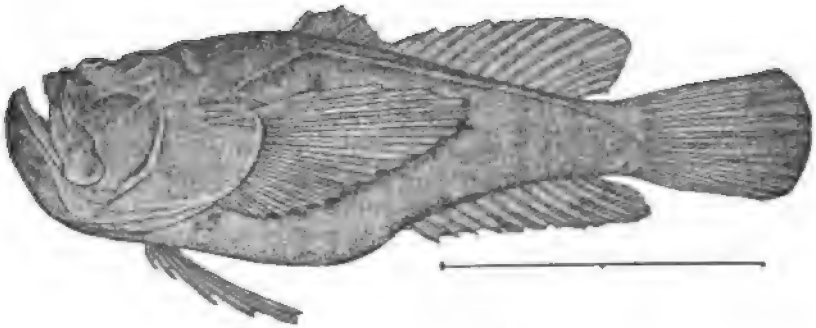
My example from Atlantic City, described in last year's report as *Astroscopus y-græcum*, after a comparison with an example from Florida, I find to be undoubtedly the present species. At that time I had not any other material available for comparison, and concluded the Atlantic City example must be distinct. It, however, appears to be nothing more than the adult of the present species. Therefore, the statement in my description that the "naked space between forks of Y on top of head long and narrow, but shorter than vertical limb of Y," is erroneous. I have also just examined a young example, taken at Beesley's Point many years ago by Samuel Ashmead. Thus so far but a single species may be said to occur on our coasts.

Upsilonphorus anoplos Abbott, Geol. N. J., 1868, p. 817.

Astroscopus y-græcum Fowler, An. Rep. N. J. State Mus.,
1905 (1906), p. 399.



Northern Star Gazer. *Astroscopus guttatus* (Abbott). (Adult.)

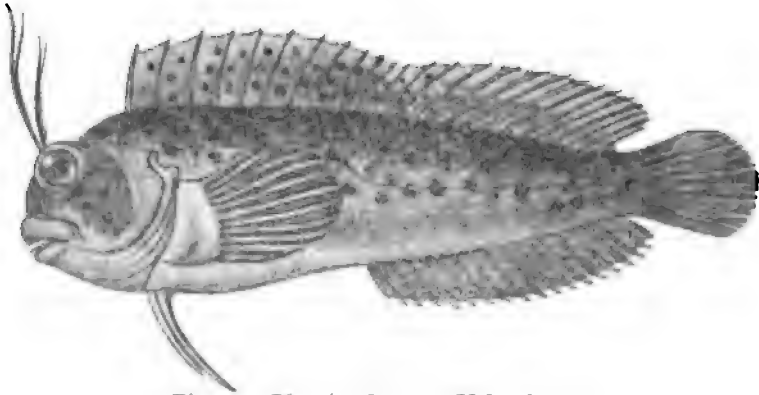


Northern Star Gazer. *Astroscopus guttatus* (Abbott). (Young.)

Family BLENNIIDÆ.*

Blennius fucorum Valenciennes.

Blenny.



Blenny. *Blennius fucorum* Valenciennes.

Hypoleurochilus geminatus (Wood).

PLATE 115.

Shell Blenny.

Family BATRACHOIDIDÆ.

Opsanus tau (Linnæus).

PLATE 116.

Toad Fish.



Toad Fish. *Opsanus tau* (Linnæus). (Young.)

Mr. Wm. J. Fox found a young example in an oyster shell at Sea Isle City, June 24th, 1906.

* I recently wrongly referred, as a new genus, *Congrammus* to this family. It is identical with *Dactyloscopus* and therefore a member of the related family *Dactyloscopidæ*.

Family GADIDÆ.***Pollachius virens* (Linnæus).**

PLATE 117.

Pollock.

Capt. Mark Castro reported, in March of 1906, that quite a number were taken off Atlantic City, sometimes 4 or 5 being brought in during 1 day.

Mr. Frank Hartman, of Palermo, Cape May County, states that he has taken small Pollock in the inlets in cold weather.

Mr. Wm. J. Fox reports 1 of about 15 pounds in weight, taken on a line with surf-clam bait at Sea Isle City early in the past December. They were also reported to have been taken in the pounds occasionally.

***Gadus callarias* Linnæus.**

Cod. Cod Fish.

Head $3\frac{1}{2}$; depth $4\frac{5}{6}$; D. II, 10-II, 18-II, 14; A. III, 17-III, 14; scales about 180 counted along lateral line to base of caudal; 20 scales between origin of first dorsal and lateral line in a vertical series; 48 scales in a vertical series between origin of first anal and lateral line; snout $2\frac{3}{4}$ in head; eye $5\frac{1}{2}$; maxillary $2\frac{1}{4}$; inter-orbital space 4; second branched ray of first dorsal $2\frac{1}{6}$; first branched ray of second dorsal $2\frac{1}{6}$; second branched ray of third dorsal $2\frac{1}{2}$; first branched ray of first anal $2\frac{3}{5}$; first branched ray of second anal 3; least depth of caudal peduncle $5\frac{1}{5}$; caudal $2\frac{3}{5}$; pectoral $1\frac{9}{10}$; ventral $2\frac{1}{10}$. Body elongate, slender, compressed, and greatest depth about middle of base of first dorsal. Head compressed, rather conic, and profiles more or less similar. Snout conic, surface convex, protruding well beyond jaws, and a little longer than broad. Eye rounded, a little high, and a trifle anterior. Mouth nearly horizontal, and upper jaw anterior to lower in front. Maxillary a little oblique, extending beyond

front rim of eye, though not to pupil, and its distal expansion about $1\frac{2}{3}$ in eye. Lips fleshy. A series of short sharp conic teeth in jaws and on vomer. Tongue broad, rounded in front, and free. Nostrils near together, anterior with a cutaneous flap, and placed near last third in length on side of snout. Interorbital space broadly and slightly convex. A single mandibular barbel a trifle less than eye. Gill-rakers $2+17$, 1, lanceolate, and longest about $\frac{4}{7}$ of longest filaments, which are about $1\frac{1}{3}$ in eye. Scales small, cycloid, in longitudinal series, largest on posterior portion of trunk, and only minute ones extending on bases of fins. Head covered more or less with minute scales, muzzle naked to nostrils. Lateral line high at first, then median to base of caudal, and with rather small wide-set tubes. Origin of first dorsal midway between tip of snout and last third in base of second dorsal, and antero-median rays highest. Second dorsal inserted a little nearer base of last ray of third dorsal than anterior nostril, and anterior rays highest. Third dorsal inserted nearer origin of second dorsal than base of caudal, and anterior rays highest. First anal inserted midway between mental barbel and base of caudal, or a trifle behind origin of second dorsal, and anterior rays longest. Second anal inserted a trifle behind origin of third dorsal or about midway between origin of first anal and base of caudal, also anterior rays highest. Caudal small, emarginate, and truncate when expanded. Pectoral with upper rays longest, $1\frac{3}{5}$ to first anal. Ventral inserted well before origin of pectoral and a trifle over half way to first anal, with second ray longest. Color in alcohol faded brownish, paler below. Length 20 inches. Sea Isle City. March 2nd, 1906. W. J. Fox.

Color when fresh olive-brown above generally, though median line of back hardly more umber or deep brown. Lower surface of body from level with mouth, base of pectoral and middle of side of caudal peduncle, opaque milky-white, in some lights with the slightest livid gray-green tints, and its surface also here and there dusted imperceptibly with very pale gray or leaden dots. This also true of sides of head, below. Head more or less uniform brownish above with olive tints, only occiput spotted finely. These spots small and crowded, begin just behind eye, extend up

on occiput, and are then distributed in varying size over most all of upper surface of body. On back superiorly and medianly they are smaller, although as they progress down laterally become more enlarged, and of rather blotched appearance. In color superior spots deep olive-brown, though becoming more yellowish towards middle of side where they are of beautiful shades, mostly golden or gilded-brown. Flanks all more or less overshot with leaden shades, and course of lateral line in a narrow leaden strip, though wider and most pronounced posteriorly or after vent. Dorsals and caudal deep olive-brown, and thick bases of each of former or more or less livid, with bright golden-brown spots indistinctly defined and so distributed to form oblique streaks, not so much inclined as fin rays when erected. Similar markings on caudal more nebulous. Anals with leaden-white bases and becoming gradually though broadly dusky-olive marginally. Edges of anals anteriorly pale. Pectoral golden-brown, paler below, leaden basally externally, and axilla pale olive with a leaden-brown spot above at origin. Ventral pale brownish-white distally, below dusted with pale olive. Lips pale translucent fleshy-brown, lower almost white. Iris pearly-white with brownish and greenish shades. Inside of gill-opening with shell-like whitish tints. Margins of dorsals and caudal more in contrast than those of anals as they are darker. Length 21 inches. Sea Isle City. Wm. J. Fox.

Reported as abundant off these shores, while the haddock was rare. The above described is about as small as they run, and are regarded by the fishermen as small-sized examples. When opened all were found to contain remains of small beach crabs, some of the shells of which measured a little over 2 inches. Mr. Fox reports it from off Sea Isle City, March 18th, 1906, and getting rather less frequent though some were still caught.

Melanogrammus æglefinus (Linnæus).

Haddock.

Head $3\frac{1}{2}$; depth $3\frac{3}{4}$; D. 16-21-21; A. 26-20; scales 158 counted along lateral line just above its course to base of caudal; 18 scales in a vertical series between origin of second dor-

sal and lateral line; about 42 scales in a vertical series between origin of first anal and lateral line; width of head $2\frac{1}{5}$ in its length; depth of head over middle of eye 2; snout $2\frac{3}{4}$; eye 5; maxillary $2\frac{7}{8}$; interorbital space 4; second ray of first dorsal $1\frac{1}{3}$; second ray of second dorsal $2\frac{1}{8}$; third ray of third dorsal $2\frac{2}{3}$; seventh ray of first anal $2\frac{1}{8}$; fourth ray of second anal 3; least depth of caudal peduncle $5\frac{1}{3}$; caudal $1\frac{9}{10}$; pectoral $1\frac{1}{2}$; ventral $2\frac{1}{5}$. Body robust, well compressed, heavy forward, and elongately ovoid. Caudal peduncle compressed, edges depressed above and below. Head robust, with more or less swollen appearance. Snout about as long as broad, with slight depression about nostrils, and protruding in front. Eye rounded, large, high and a little anterior in head. Mouth moderate, transversely inferior, and upper jaw protruding a little in front of lower. Maxillary more or less concealed, reaching front of eye. Bands of small teeth in jaws, also on vomer. Tongue thick, fleshy and a little free in front. Nostrils a little nearer eye than tip of snout, close together, anterior with a small cutaneous flap, and posterior larger. Occiput resolving into a median convex osseous keel. Gill-rakers 3 + 21, lanceolate, short, and largest about half of largest filaments, which are about $\frac{3}{4}$ of eye. Scales more or less imbedded, cycloid and thin. Scales on head all minute, absent from muzzle, and those on opercle very small. Scales on predorsal region and back above to third dorsal all very small and of crowded appearance. Small scales on base of caudal, otherwise fins naked. Lateral line conspicuous and more or less concurrent with dorsal profile. First dorsal inserted opposite origin of pectoral, and rays graduated down from second which is longest. Second dorsal inserted a trifle before tip of pectoral, its base longest of dorsal fins, and graduated down from third ray which is longest. Third dorsal inserted nearer origin of second dorsal than base of caudal, and rays graduated down from fourth which is largest. First anal inserted opposite origin of second dorsal, though fin much larger, and graduated down from about sixth ray which is longest. Second anal inserted a trifle after origin of third dorsal, and of about similar size. Caudal broad, with posterior edge emarginated. Pectoral pointed, reaches a trifle beyond origin of first

anal, and upper rays longest. Ventrals inserted a little before origin of pectoral, second ray prolonged into a filamentous tip, and reaching about $\frac{4}{7}$ of space to origin of first anal. Vent large, close in front of first anal. Color when fresh deep olivaceous-umber on back and upper surface, edge of each scale somewhat shaded deeper. Below lateral line sides paler and becoming still paler below or whitish. All these regions soiled with dull umber tints. Dorsals and caudals dull or pale translucent brownish, former all becoming livid brownish-white basally. Anals white becoming soiled grayish on outer portions. Pectoral dull grayish-brown, livid or pale on under side or lower side. Ventral whitish, dotted with dull brownish. Lateral line deep blackish-brown. A deep umber-brown blotch a trifle larger than orbit over middle of length of pectoral. Iris silvered whitish. Length $27\frac{1}{2}$ inches. Sea Isle City. December 5th, 1906. Wm. J. Fox.

Mr. Fox reports that they are occasionally taken by the line fishermen at Sea Isle City during cold weather.

Family LOPHIIDÆ.

Lophius piscatorius Linnæus.

Angler.

Abundant during early spring off Holly Beach. When captured and held up by the tail they sometimes will allow large quantities of fish, which they have swallowed, to slip out.

Family ANTENNARIIDÆ.

Pterophryne histrio (Linnæus).

PLATE 118.

Mouse Fish.

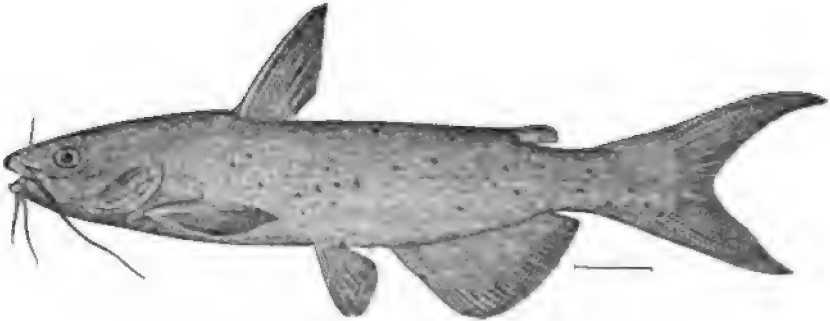
APPENDIX.

INTRODUCED SPECIES.

Family SILURIDÆ.

Ictalurus punctatus (Rafinesque).

Spotted Cat Fish.



Spotted Cat Fish. *Ictalurus punctatus* (Rafinesque).

Ameiurus lacustris (Walbaum).

Lake Cat Fish.



Lake Cat Fish. *Ameiurus lacustris* (Walbaum).

Family SALMONIDÆ.

***Salmo fario* Linnæus.**

PLATE 119.

Brown Trout.

***Salvelinus alpinus* (Linnæus).**

PLATE 120.

Saibling.

Family ESOCIDÆ.

***Esox masquinongy* (Mitchill).**

PLATE 121.

Muskallunge.

Family MICROPTERIDÆ.

***Pomoxis annularis* Rafinesque.**

PLATE 122.

Crappie.

Glossary of Technical Terms Relative to Amphibians and Reptiles.

Abdomen. Belly.

Abdominal cavity. Chamber of the cœlome containing the viscera.

Abdominal shield. Posterior, or larger, of large shields on plastron joining bridge in most turtles.

Abdominal vein. Vein extending from the pelvic veins to the liver.

Abducent nerves. Sixth pair of cranial nerves, supplying the external rectus muscle of the eye.

Abductor. A muscle that draws away from the middle of the body.

Accessory nerves. Eleventh pair of cranial nerves, supplying muscles of the shoulder.

Acetabulum. Surface for articulation of hind limb on pelvic-girdle.

Acrodont. Teeth fixed by their bases to summit ridge of the jaw.

Adductor. A muscle that draws towards the middle of the body.

Adrenal bodies. A gland on the ventral surface of each kidney.

Afferent. Conducting inward. Said of arteries, which convey aërated blood.

Alisphenoid. A small bone on the front side wall of the brain-case.

Alveola. Teeth-sockets.

Alveolar surface. Part of turtle's jaw, where alveola develop in other reptiles.

Amphiarthrosis. A joint in which bony surfaces are united by intervening fibrous or fibrocartilaginous substance, so as to permit of slight movement, as in the vertebræ.

Amphicælian. Double-concave, usually referring to vertebræ.

Ampulla. A dilation at the end of the semi-circular canal.

Anal. With reference to the anus or vent.

Anal plate. Plate just in front of vent in serpents, usually divided by a median suture.

Anal shield. Posterior pair of shields or plates on plastron of turtles.

Anchylosed. Firmly grown together.

Angular. A small bone on back end of lower jaw.

Angulo-splénial. Membrane borne along inner face of mandible.

Annulus tympanicus. Ring of cartilage supporting tympanum.

Anteorbital plate. Preorbital plate. Preocular plate. Developed as 1 or 2 plates in front of eye in serpents, and its longest diameter usually vertical.

Antrorse. Turned forward.

Anus. Vent. External opening of intestine.

Aqueous humor. A watery fluid filling the anterior chamber of the eye.

Arboreal. Dwelling in trees.

Archinephric duct. Tube connecting the embryonic pronephros with the cloaca.

Articular. Bone of lower jaw supporting dentary.

Articulate. Jointed.

Astragalus. Inner tarsal bone.

Atlas. First vertebra.

Atrophy. Non-development.

Attenuate. Long and slender, as if drawn out.

Auditory capsules. Posterior region of skull on each side of the brain-case.

Auditory nerves. Eighth pair of cranial nerves, supplying the organ of hearing.

Auricle. A chamber of heart.

Autogenous. Self-produced, as skeletal parts developed from ossification centers.

Autostylic. Having the mandibular suspensorium suspended by the quadrate.

Axis. The second vertebra.

Azygous. Occurring singly.

Basioccipital. A lower median hind bone of the skull which attaches the atlas.

Basis cranii. The basioccipital, basisphenoid and presphenoid together at the base of the skull.

Basisphenoid. Bone in front of basioccipital forming the floor of the skull.

Beak. Any bill-like structure.

Biceps. A double-headed muscle.

Bicolor. Two-colored.

Bicuspid. With 2 points.

Brachial veins. Veins carrying the blood from the fore limb to the sinous venosus.

Branchiæ. The gills or respiratory organs of most salamanders and young amphibians.

Bridge. Junction of the carapace, at the sides, with the plastron, in turtles.

Buccal. Relating to the mouth.

Bulbus aortæ. A ramification of the conus arteriosus.

Caducous. Soon falling off.

Cæcal. Of blind sack-like form.

Cæcum. Blind sack-like appendage connected with alimentary canal at posterior end of stomach.

Calcaneum. Outer tarsal bone.

Calcar. Spur on inner hind edge of foot.

Canines. Any conical teeth in jaws longer or larger than the others.

Capitular. In form of a small round body like the head of a rib.

Carapace. Upper shell of a turtle, usually composed of bony plates covered with horny scales.

Cardiac vein. Vein from the heart to the abdominal vein.

Cardiform teeth. Coarse and sharp teeth, like wool cards.

Carinate. Keeled, usually with reference to a ridge along median line.

Carotid artery. A division of the carotid trunk.

- Carotid trunk.* Ramification anteriorly of the bulbus aortæ.
- Carpals.* Wrist-bones.
- Carpus.* The wrist.
- Caudal fin.* Fin at or on the tail.
- Cavernous.* Containing cavities, either empty or filled with mucous.
- Centralia.* Middle row of carpal and tarsal bones.
- Centrum.* Body of a vertebra.
- Ceratohyal.* Median segment of the hyoid cornu.
- Cerebellum.* The epencephalon. Anteriorly part of and derived from hind brain.
- Cervical.* With reference to the neck.
- Cervical vertebrae.* Vertebra or vertebrae of the neck.
- Chiasma.* Crossing of the optic nerve fibers.
- Chin.* Space at front of lower jaw.
- Choana.* An opening into a funnel-like cavity, like one between nasal passages and pharynx.
- Choroid.* The second coat of the eye lining the sclerotic.
- Choroid plexus.* Thickened vascular regions of the pia mater in contact with the thin epithelial roofs of the diencephalon.
- Ciliary muscle.* Unstriated muscular fibres of the ciliary processes.
- Ciliary processes.* Radiating folds at anterior or outer portion of the choroid, where joining the iris.
- Cirri.* Fringes.
- Clavicle.* Collar-bone, or lower anterior part of shoulder-girdle, not entering arm-socket.
- Cleithrum.* A bone on each side of interclavicle.
- Cloaca.* Opening of alimentary, urinary and genital canals.
- Cochlea.* A posterior blind pouch of the sacculus.
- Columella.* Cartilage bone attached to the stapes.
- Commisure.* Line between two plates or scales.
- Compressed.* Flattened laterally.
- Condyle.* Articulating surface of a bone.
- Conus arteriosus.* Main ramification of the heart below, or a fourth chamber of the heart in front of the ventricle.
- Coracoid.* Cartilage or bone on ventral side forming part of arm-socket.
- Cornea.* A transparent membrane on the outer or exposed portion of the eye replacing the sclerotic.
- Cornua.* Slender rods of the hyoid apparatus.
- Corpora striata.* Floor of fore brain.
- Cortex.* A thin superficial layer of gray matter in the hemispheres and cerebellum.
- Costal folds.* Plications or grooves showing position of costæ, or ribs, in salamanders.
- Costal plates.* Immovable ribs forming greater portion of the roof of the carapace in turtles.
- Costal shields.* A series of about four plates or shields along side of carapace between the vertebral and marginals, in turtles.
- Costiform.* Rib-like.
- Cranial.* Relating to the skull.

Cristæ acusticæ. Sensory cells produced into hair-like processes in the organ of hearing.

Crura cerebri. The thickened ventral wall of the mid-brain in the form of two longitudinal bands.

Cuneate. Wedge-shaped.

Cutaneous artery. A division of the pulmo-cutaneous trunk to the skin.

Deciduous. Falling off, or temporary.

Dentary. Principal bone in front of lower jaw usually bearing teeth.

Dentate. With tooth-like notches.

Depressed. Flattened vertically.

Depressor. A muscle that lowers.

Depth. Usually vertical diameter of body.

Dermal. Relating to the skin.

Diacele. Third ventricle of the brain.

Diaphanous. Translucent.

Diaphragm. Muscular septum between thorax and abdomen.

Diapophysis. Transverse process of a vertebra.

Diencephalon. Posterior portion of the fore brain.

Digitigrade. Walking on toes.

Distal. Remote from point of attachment.

Distalia. Third row of carpal and tarsal bones.

Dorsal. Relating to the back.

Dorsal aorta. Formed by the systemic trunks curving around and above the gullet, and uniting.

Duodenum. First portion of the intestine.

Dura mater. Tough membrane lining the cerebro-spinal cavity.

Ecdysis. Casting and renewal of the outer layers of the horny epidermis in reptiles.

Ectopterygoid. Pterygoid bone.

Efferent. Conducing outward. Said of veins as they carry out non-aërated blue blood.

Elevator. A muscle that raises.

Emarginate. Slightly forked or notched.

Endolymph. A fluid filling the organ of hearing.

Endolymphatic duct. A narrow tube from the inner face of the sacculus.

Endoskeleton. Skeleton proper, or inner bony frame-work of the body.

Enteron. Alimentary canal.

Entoplastron. Median anterior bony plate of the plastron behind the epiplastra and in front of the hypoplastra, in turtles.

Epencephalon. Cerebellum.

Ependyme. Purely non-nervous epithelial layer as that of the floor of the medulla oblongata.

Epicæle. Cerebellar ventricle of the brain.

Epicoracoid. Bones or cartilages connecting coracoid and precoracoid ventrally.

Epidermis. Outer or epithelial layer of the skin.

Epignathous. Upper jaw hooked over tip of lower.

- Epiotic.* A bone on side skull, forming roof of each auditory capsule.
- Epiphysis.* The original narrow hollow outgrowth of the pineal apparatus.
- Epiplastra.* First pair of median bones of the plastron, in turtles.
- Epipterygoid.* A slender rod of bone extending down nearly vertically from prootic to pterygoid, in some lizards.
- Episternum.* Bony rod passing from anterior ends of united epicoracoids.
- Erectile.* Susceptible of being raised or erected.
- Ethmoid.* A median bone in front of skull.
- Eustachian tubes.* Short tube connecting the mouth and tympanic cavity.
- Exoccipitals.* Two bones in the back of the skull, one on each side of the foramen magnum.
- Exoskeleton.* Outer skeleton, or such hard parts on the surface of the body as scutes, scales, etc.
- Exserted.* Projecting beyond the general level.
- Extensor.* A muscle that straightens.
- Extensores dorsi.* Longitudinal or oblique band-like muscles along the back.
- Extralimal.* Beyond the limits.
- Facial.* Relating to the face.
- Facial nerves.* Seventh pair of cranial nerves, supplying the palatine, by mandibular and ophthalmic nerves.
- Falcate.* Sickle-shaped.
- Falciform.* Curved like a sickle.
- Fauna.* Animals inhabiting any region considered collectively.
- Femoral.* Relating to the femur, or proximal bone of the hind limb.
- Femoral pores.* A series of pores on inferior femoral region in most lizards.
- Femoral shields.* A pair of shields just before the anal pair on the plastron of turtles.
- Femoral veins.* Veins carrying blood from front of hind leg, which ramifies into the renal portal veins and the pelvic veins.
- Femur.* Thigh bone of the hind limb.
- Fenestra ovalis.* An aperture of the prootic.
- Fibula.* Smaller outer bone of hind limb.
- Filament.* A slender thread-like structure.
- Filiform.* Thread-form.
- Flexor.* A muscle that bends.
- Fontanel.* An unossified space on top of head covered with membrane.
- Foramen.* A hole or opening.
- Foramen of Monro.* A narrow passage connecting the paracoele and diacoele.
- Forehead.* Frontal curve of head.
- Forficate.* Scissors-like.
- Fossæ.* Usually grooves in which the nostrils open.
- Fossorial.* Adapted for digging.
- Frontal bone.* Front bone on top of head, usually paired.
- Frontal plate.* Usually a single large scaly plate on top of head between eyes, on some serpents.
- Frontoparietal plates.* A pair of scaly plates, behind the frontal, in lizards.
- Fusiform.* Spindle-shaped, or tapering at both ends.

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Gall-bladder. A membraneous sac for temporary retention of the bile at lower edge of the liver.

Ganglion. A nerve center.

Gape. Opening of mouth.

Gastrocnemius. Muscle in the calf of the leg.

Genial plates. Usually two pairs, anterior and posterior, between mandibular labials, in serpents.

Gills. Organs for breathing air in water. Branchiæ.

Glabrous. Smooth.

Glenoid cavity. Surface for articulation of fore-limb on shoulder-girdle.

Glomerulus. A bunch of looped capillaries formed by the breaking up of each minute afferent artery from the renal arteries.

Glossohyal. Tongue-bone.

Glossopharyngeal nerves. Ninth pair of cranial nerves, supplying the pharynx.

Glottis. Narrow slit-like communication between the mouth and the lungs.

Gonads. Reproductive organs.

Graduated. Progressing or decreasing in length, usually with reference to spines or rays in series.

Granulate. Finely roughened.

Gular. Relating to upper foreneck.

Gular shields. Usually the first pair of shields on the plastron of turtles.

Gullet. Œsophagus, or the alimentary canal between the pharynx and the stomach.

Hæmal arch. Bony arch formed from lower part of the centrum.

Hallux. The large toe.

Height. Vertical diameter.

Hepatic portal vein. Vein carrying blood from the stomach, intestine, spleen and pancreas to the abdominal vein.

Humeral shields. The second pair of shields on the plastron of turtles, or those just before the bridge.

Humerus. The proximal bone of the fore limb.

Hyoid. Relating to the tongue.

Hyoid apparatus. Series of bones inside lower jaw supporting the tongue.

Hyomandibular. A bone by which the posterior end of the suspensorium articulates with the skull; the supporting element of the suspensorium, mandible, hyoid and opercular bones.

Hyoplastra. First pair of large median bones of plastron, forming front of the bridge, in turtles.

Hypercoracoid. Upper of two bones attached to the clavicle.

Hypocoracoid. Lower of two bones attached to clavicle behind.

Hypoglossal nerves. Twelfth pair of cranial nerves, supplying muscles of the tongue and certain neck muscles.

Hypophysis. Pituitary body.

Hypoplastra. Second pair of large median bones of plastron, forming hind part of bridge.

Ilium. Anterior dorsal pelvic bone.

Imbricate. Overlapping.

Imperforate. Not pierced through.

Inarticulate. Not jointed.

Incisors. Front cutting teeth.

Infralabial plates. Under scaly labial plates, or those below mandibular labials, in lizards.

Inframarginal shields. The first and last shields of the bridge, on the plastron of turtles.

Infraoral. Below mouth.

Infundibulum. A funnel-like prolongation from the floor of the diencephalon.

Inscriptiones tendineæ. Transverse bands of fibrous tissue traversing at intervals the extensores dorsi and rectus abdominis muscles.

Interclavicle. A median ventral membrane bone connected on each side with clavicle, extending backwards ventral to sternum.

Interfrontonasal plate. A scaly plate in lizards, between the internasals and prefrontals.

Intergular shield. Usually the first, a single shield, at the front of the plastron of turtles.

Intermedium. Carpal bone between end of ulna and radius, and tarsal bone between end of tibia and fibula.

Internasal plates. A pair of scaly plates behind the rostral and between the nasals, in lizards and snakes.

Interorbital. Between eyes.

Interparietal plates. A narrow scaly plate separating the parietals in lizards.

Interposition. Placed between.

Iris. A circular pigmented membrane placed behind the cornea and presenting the characteristic color of the eye.

Ischium. Posterior dorsal pelvic bone.

Iter. Aqueduct of Sylvius, or median portion of the mesocœle.

Jacobson's organ. An offshoot from the olfactory organ, opening into the mouth.

Jugal. A bone of the zygomatic arch. Malar bone.

Jugular. Relating to the lower throat.

Jugular veins. Veins on the sides of the head carrying the blood to the pre-caval vein.

Keeled. Furnished with a ridge along the median line.

Kidney. A massive gland of deep red color, secreting the urine.

Labials. Plates along each lip in serpents.

Lachrymal. Preorbital bone.

Lacustrine. Living in lakes.

Lamellæ. Plate-like processes.

Lamina. Plate. Bony roof of the neural canal.

Lamina terminalis. Thin front wall of the diencephalon.

Larva. An immature form which must undergo change of appearance before becoming adult.

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Laterally. Sidewise.

Lens. Concentric layers of fibres in close contact with and immediately behind the iris.

Linea alba. A longitudinal band of tendon uniting right and left rectus muscles.

Lingual artery. A division of the carotid trunk.

Liver. A large organ of the alimentary canal near the thorax secreting the digestive juice or bile.

Loreal plate. Scaly plate just before eye in lizards, and in same place, though with preoculars between, in snakes.

Lunate. Form of new moon or crescent-shaped.

Lymph. Fluid contained within the lymph-vessels, as blood without red corpuscles.

Lymph hearts. Two pairs of muscular dilatations in the course of certain vessels pumping lymph into the viens, one beneath the supra-scapulæ and the other beside the posterior end of the urostyle.

Macula acustica. Sensory cells produced into hair-like processes in the organ of hearing.

Malpighian capsule. Blind or globular dilatation of each urinary capsule.

Mandible. Lower jaw.

Marginal plates. Bony plates along the edges of the costal plates in turtles.

Maxilla. Upper jaw.

Maxillary. Bone in each side of upper jaw following maxillary.

Meckel's cartilage. The core of the mandible.

Medula oblongata. Metencephalon.

Medullary groove. A dorsal groove of the embryo, which unites and encloses a tube, to form the nervous system.

Membranous labyrinth. The auditory organ.

Mental plate. First plate at tip of mandible in lizards.

Mento-meckelian. Distal end of mandibular cartilage.

Mesencephalon. Mid-brain.

Mesentery. Folds of the peritoneum supporting the stomach, intestine, liver, pancreas, spleen, etc.

Mesethmoid. Ethmoid.

Mesocæle. Mid-ventricle of the brain.

Mesonephros. The mid-kidney.

Mesoplastron. Bone on side of plastron between hyo- and hypoplastron, in fossil turtles.

Metacarpus. The hand, without the fingers. The metacarpals.

Metacæle. Fourth ventricle of the brain.

Metamorphosis. A change from one form to another.

Metanephric duct. A diverticulum given off from the posterior end of the Wolffian duct and connecting with the metanephros.

Metanephros. The hind or permanent kidney.

Metatarsus. The foot, without the toes. Metatarsals.

Metencephalon. Medulla oblongata, or posterior derivation of the hind brain.

Minimus. Fifth digit of each limb.

Muciferous. Producing or containing mucous.

Mullerian duct. A longitudinal division of the archinephric duct opening into the coelome near the vanishing pronephros.

Musculo-cutaneous veins. Veins carrying the blood from the skin and muscles on the side and back, and part of the head, to the brachial veins.

Nape. Neck above, next to the occiput.

Nares. Nostrils.

Nasal bone. Pair of bones of the nose in front of the frontals.

Nasal plates. Scaly plate, or plates, in which the nostril is placed, or placed between, in lizards and snakes.

Neural arch. Bony arch formed from upper part of the centrum.

Neural plates. Flattened neural spines forming median bony framework of the carapace in turtles.

Neural spine. Uppermost spine of a vertebra.

Nictitating membrane. Third or inner eyelid.

Notocord. A cellular cord, preceding the vertebral column, in the embryo.

Nuchal shield. The most anterior of the median marginal shields on the carapace of turtles.

Obliquus externus. A layer of oblique muscular fibres extending from the vertebral column to the recti.

Occipital. Relating to the occiput.

Occipital plates. A pair of narrow plates behind the parietals in lizards and serpents.

Occiput. Back of head above.

Ocellate. Eye-like, usually roundish with a lighter or darker border.

Oculomotor nerves. Third pair of cranial nerves, supplying muscles of the eyes.

Oid. Like, as a suffix, such as.

Olfactory capsules. Front region of skull on each side of the brain-case.

Olfactory nerves. First pair of cranial nerves, supplying the organ of smell.

Omosternum. Plate of cartilage at end of episternum.

Opisthocælian. Concave behind only, usually referring to ball-and-socket-jointed vertebræ.

Opisthotic. Bone of skull to which lower limb of post-temporal usually articulates.

Optic lobes. Paired oval swellings from the dorsal wall of the mid-brain.

Optic nerves. Second pair of cranial nerves, supplying the organ of sight.

Optic thalmi. The thickened sides forming paired masses to the diencephalon.

Optocæle. Ventricle of the optic lobe.

Ora serrata. A very delicate membrane over the ciliary processes and the posterior face of the iris.

Orbicular. Nearly circular.

Orbit. Eye-socket.

Orbitosphenoids. Paired bones at presphenoid, forming side walls to the inter-orbital regions.

Osteology. Study of bones.

Otic process. A proximal fork of the suspensorium fusing with the auditory region of the cranium.

Oviparous. Producing eggs developed after exclusion from the body.

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Ovoviviparous. Producing eggs hatched before exclusion from the body.
Ovum. Egg.

Palate. Roof of mouth.

Palatines. A pair of membrane bones on roof of mouth, one on each side of vomer.

Pallium. Roof of the fore brain.

Palustrine. Living in swamps.

Pancreas. An irregular gland, usually surrounding the bile-duct, into which it pours its secretion.

Papilla. A small fleshy projection.

Paracæle. A cavity in each cerebral hemisphere.

Paradiapophyses. Rudimentary transverse processes on vertebræ of turtles.

Paraphysis. An outgrowth of the roof of the fore brain developed in front of the epiphysis in the hinder region of the prosencephalon.

Parapineal eye. A second eye-like body or diverticulum of the epiphysis.

Parasphenoid. Bone on roof of mouth following vomer.

Parencephala. Cerebral hemispheres.

Parietal. Bone on side of head above.

Parietal plates. In snakes, usually pair of large scaly plates behind the frontal. In lizards, separated from the frontal by the front parietals.

Parotid. A gland or swelling behind eye in toads.

Pectinate. Toothed like a comb.

Pectoral. Relating to the breast.

Pectoralis. The principal muscle of the chest.

Pectoral shields. Usually first pair of large shields on the carapace of turtles, or those joining with the front of the bridge.

Pedicle. Upper lateral process of centrum. A proximal fork of the suspensorium fusing with the trabecular region of the cranium.

Pelvic girdle. Bones supporting hind limbs.

Pelvic vein. Vein extending from the femoral vein to the abdominal vein.

Pelvis. Bones to which hind limbs are attached.

Pentadactyle. Five-toed.

Perforate. Pierced through.

Pericardium. Cavity in which the heart is placed.

Peritoneum. Membrane lining abdominal cavity.

Phalanges. Bones of the fingers and toes.

Pharynx. Posterior, or branchial cavity, of the head.

Pia mater. A delicate membrane covering the brain and spinal cord.

Pigment. Coloring matter.

Pineal apparatus. A peculiar adjunct to the roof of the diencephalon.

Pineal body. Usually the epiphysis represented as a gland-like structure, connected with the roof of the diencephalon by a hollow or solid stalk. In other words, a small ganglion in the brain, a rudiment of an optic lobe connected with a third or median eye.

Pineal eye. The eye-like body or diverticulum of the epiphysis. Pineal body.

Pituitary body. A pouch formed in roof of the buccal cavity of the embryo, the pituitary diverticulum, growing upwards loses its connection with

the mouth and becomes attached to the ventral surface of the brain. The dilated end of this diverticulum and the end of the infundibulum form the gland-like pituitary body.

Planta. Sole of foot.

Plantigrade. Walking on the soles of the feet.

Plastron. Lower shell of a turtle.

Pleurodont. Teeth fixed by their bases to lateral surface of ridge of jaw.

Plicate. Folded so as to show transverse folds or wrinkles.

Plumbeous. Lead-colored or dull bluish-gray.

Pollex. Thumb.

Post-caval vein. A large dorsal vein connecting the hepatic veins with the renal veins.

Postfrontal plates. Parietal plates, on serpents.

Postmental plate. Second scaly plate at end of mandible in lizards.

Postocular plate. One or two scaly shields behind eye, in serpents.

Postorbital. Behind eye. Postocular.

Postorbital plates. Postoculars. One or more scaly plates behind the eye, before the temporals, in snakes.

Post-temporal plates. One or more scaly shields, comprising third row, behind eye.

Preanal plates. A single or divided scaly plate, before the vent in lizards and snakes.

Precaval veins. Ramifications of the sinous venosus which ramify into the jugular and brachial veins.

Precoracoid. Portion of coracoid more or less separated from rest.

Prefrontal plates. A pair of plates just before the frontal, in lizards and snakes.

Preloreal plate. First of scaly loreal plates, in lizards.

Premaxillary. Front bone of the upper jaw.

Preocular. Before eye.

Preocular plates. Preorbital plates.

Preorbital plates. Preoculars. One or more scaly plates before the eye, in serpents.

Presphenoid. A median continuation forwards of the basisphenoid.

Procaëlian. Concave in front only.

Projectile. Capable of being thrust forward.

Pronephros. The fore kidney, usually deciduous.

Prootic. Bone forming front side of brain-case.

Prosencephalon. Anterior portion of the fore brain.

Prosocæle. Fore ventricle of the brain.

Protractile. Capable of being drawn forward.

Proximal. Nearest.

Pterotic. Bone at side process back on skull.

Pterygoids. Bones on roof of mouth behind palatines.

Pubic bones. Lower pelvic bones.

Pulmo cutaneous trunk. Outer or posterior ramification of the bulbous aortæ.

Pulmonary. Relating to lungs.

Pulmonary artery. A division of the pulmo-cutaneous trunk to the lung.

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Pulmonary veins. Veins carrying purified blood from the lungs to the left auricle.

Pupil. A slit-like perforation in the middle of the iris.

Pygal plate. Posterior neural plate of a turtle's carapace.

Quadrate. Bone of suspensorium to which mandible is hinged.

Quadratojugal. Posterior bone of upper jaw, behind maxillary, and connecting with quadrate.

Quincunx. Set of 5 arranged ::

Radiale. Carpal bone at end of radius.

Radius. Outer smaller bone of fore limb.

Ranoid. Frog-like, etc.

Ray. Cartilaginous rod supporting membrane of a fin.

Rectum. Last portion of the intestine.

Rectus abdominis. A paired ventral band of muscles.

Recurved. Curved upward.

Renal portal veins. Veins extending from the femoral veins to the kidneys.

Reticulate. Marked like a network.

Retina. The delicate transparent innermost membrane lining the choroid.

Retractable. Capable of being drawn in.

Retrorse. Turned backward.

Rhinencephalon. The olfactory lobe, a prolongation of each hemisphere of the brain.

Rhinocæle. The olfactory ventricle.

Rictal. Relating to the rictus.

Rictus. Corner or gape of mouth.

Rostral. Relating to the snout.

Rostral plate. Scaly plate at tip of snout in front, in lizards and snakes.

Rudimentary. Undeveloped.

Rugose. Rough with wrinkles.

Sacculus. Ventral compartment of the organ of hearing.

Sacral. Relating to the sacrum.

Sacral vertebræ. Vertebræ of the tail.

Scapula. Shoulder-blade.

Scapular arch. Shoulder-girdle.

Schneiderian membrane. The olfactory mucous membrane.

Sciatic vein. A vein extending from the back of the hind leg to the renal portal vein.

Sclerotic. The optic capsule.

Scute. External bony or horny plate.

Semicircular canals. Tubes, usually three, in the dorsal compartment of the organ of hearing.

Septum. A thin partition.

Septum auricularum. Partition separating the auricles.

Serrate. Notched like a saw.

Sessile. Without a stem.

Setaceous. Bristly.

Setiform. Bristle-like.

Shaft. Stiff axis.

Shoulder-girdle. Bony girdle back of head forming attachment to front limbs.

Sigmoid. Curved like the letter S.

Sinus venosus. Main ramification of the heart above.

Spatulate. Spoon-shaped.

Sphenethmoid. Bone at front of auditory capsule.

Sphenoid. Basal bone of skull.

Sphenotic. Side bone of skull.

Spine. A sharp projecting point.

Spiracles. Openings in head and neck as in some amphibians.

Spleen. A small red globular body.

Squamosal. Bone supporting the suspensorium.

Stapes. A nodule of cartilage in the fenestra ovalis.

Stellate. Star-like, or with radiating ridges.

Sternum. Bone passing back from the epicoracoids.

Striate. Striped or streaked.

Sub. Part, less than, not quite, under, somewhat, etc.

Subcaudal. Under the tail.

Suborbital. Below the eye.

Subulate. Awl-shaped.

Suffrago. Heel joint, that of tibia and tarsus.

Superciliary. Relating to above the eyebrow.

Superciliary plates. A series of small scaly plates, over the eyes of lizards.

Supracaudal shields. Last pair of median marginal shields on the carapace of turtles.

Supraoccipital. Bone forming upper back roof to skull.

Supraocular plates. Scaly plates on each side of frontal over the eyes of lizards and snakes. Sometimes called superciliary plates.

Supraoral. Above the mouth.

Supraorbital. Above the eye.

Supraorbital plates. Supraocular plates, or those above the eye.

Suprascapula. Bone above scapula.

Suspensorium. Posterior region of the palato-quadrate bone.

Suspensory ligament. Attachment of the lens to the ciliary processes.

Suture. Line of union of two bones.

Symphyseal plate. Scaly plate at tip of the mandible in serpents.

Symphysis. Point of junction of two parts, of lower jaw as tip of chin.

Synonym. A different name with the same or similar meaning.

Synonymy. A collection of different names for the same group, species or thing.

Systemic trunk. Aortic arch. Ramification medianly of the bulbous aortæ.

Tail. Part of body posterior to vent.

Tarsals. Ankle-bones.

Tarsus. Ankle-bones collectively.

Temporal. Relating to the temples.

Temporal shields. One or more plates on side of head in some snakes just after the postorbitals.

Tendon. Strong fibrous tissue serving to fix a muscle to the bones upon which it acts.

Terete. Cylindrical and tapering.

Terminal. At the end.

Tessellated. Marked with little checks or squares, like mosaic work.

Thoracic. Relating to the chest.

Thymus glands. Small paired organs behind and below the tympanic membrane in the pharynx.

Thyroid glands. Small paired organs lying below the floor of the mouth, in front of the glottis, in the pharynx.

Tibia. Skin bone, or inner bone between the heel and the knee.

Transverse process. Lateral process of the neural canal.

Trenchant. Compressed to a sharp edge.

Trigeminal nerves. Fifth pair of cranial nerves, supplying the ophthalmic, mandibular, maxillary and gustatory nerves.

Trochlear nerves. Fourth pair of cranial nerves, supplying only the superior oblique muscle of the eye.

Truncate. Abrupt, as if cut off square.

Tubercle. A small excrescence like a pimple.

Tympanum. Ear-drum, external in some amphibians.

Type. (Of the genus.) A species on which a genus is based.

Type. (Of the species.) A particular specimen on which the original specific description was based.

Type locality. The particular place or locality where the type specimen was found.

Typical. Of a structure most usual in a given group.

Ulna. Inner bone of forearm.

Ulnare. Carpal bone at end of ulna.

Ultimate. Last or farthest.

Uncinate. A flattened curved cartilage to each rib posteriorly in lizards.

Unguiculate. Furnished with claws.

Unicolor. Of a single color.

Urinary bladder. A dilatation of the ureter serving as a receptacle for the urine.

Urinary tubules. Convoluted substances forming the kidney.

Urostege. Plates on lower surface of tail in serpents. Post-ventral plates.

Urostyle. Slender bony rod in pelvic-girdle following vertebræ.

Utriculus. An irregular chamber in the dorsal compartment of the organ of hearing.

Vagus nerves. Pneumogastric or tenth pair of cranial nerves, supplying the cardiac, gastric, lateral, pulmonary and laryngeal nerves.

Vasa deferentia. Tubes connecting the testes with the Wolffian bodies through which the reproductive products are discharged.

Vent. Anus.

Ventral. Relating to the abdomen.

Ventral aorta. A large thick-walled elastic blood-vessel originating in the bulbous aortæ.

Ventral plates. Gastrosteges. A row of shields along belly between throat and vent.

Ventricle. One of the thick-walled chambers of the heart.

Ventricles. Brain chambers.

Versatile. Capable of being turned either way.

Vertebra. One of the spinal column bones.

Vertebral shields. Median series of shields on the carapace of turtles.

Vertical. Up and down.

Vertical plate. Frontal plate on top of head in lizards and snakes.

Vesical vein. Vein from the urinary bladder to the abdominal vein.

Vestibule. The utriculus and sacculus when spoken of together.

Villiform. Usually of slender crowded teeth in velvety bands.

Viscous. Slimy.

Vitreous humor. A gelatinous substance filling the posterior chamber of the eye.

Viviparous. Bringing forth living young.

Vocal vesicle. A loose fold of skin at angle of the mouth in some male frogs. This can be inflated at will to a spherical form during croaking. In the toads the throat simply swells out and retracts as the croaking is emitted.

Vomer. Paired or single bone on roof of mouth in front.

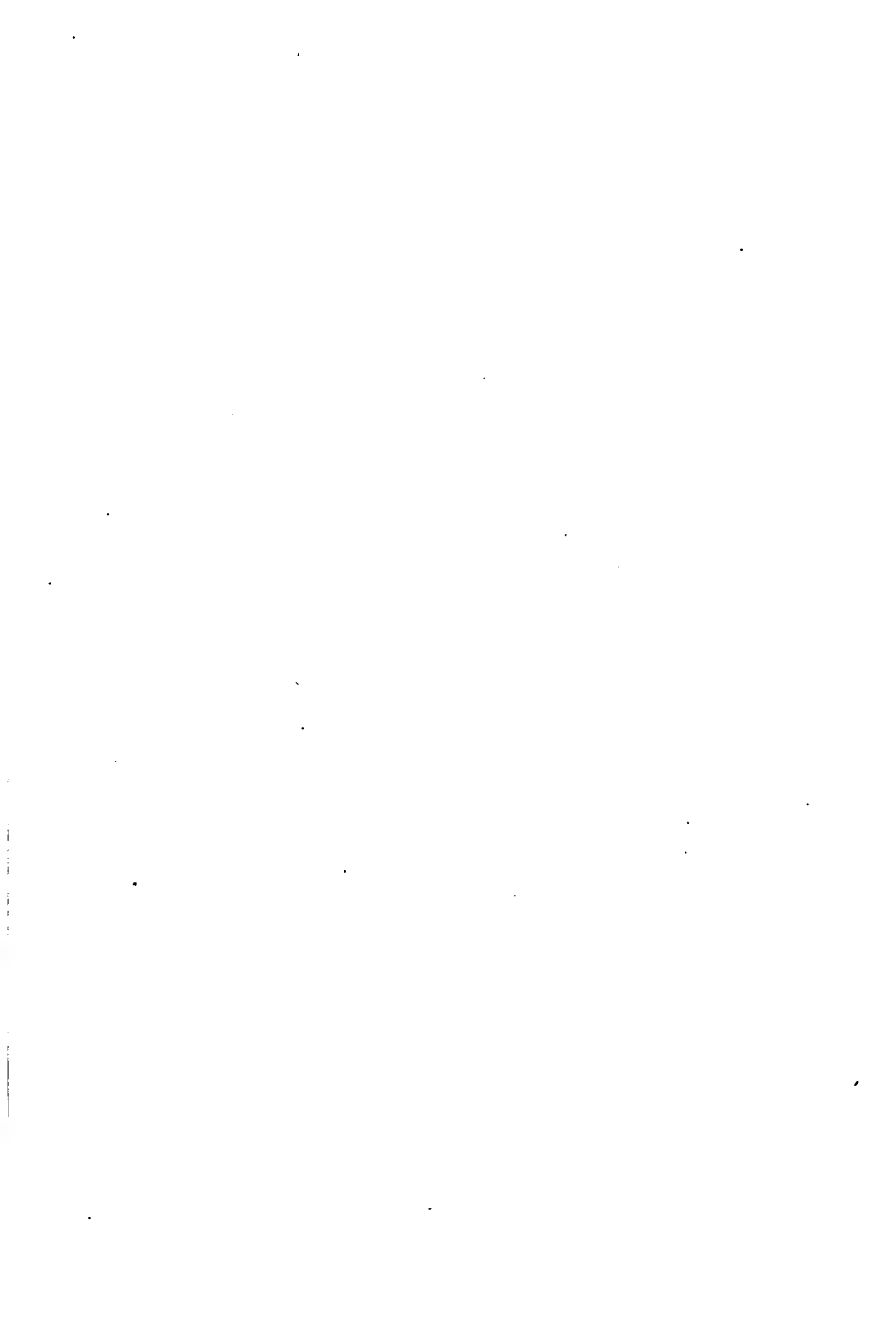
Web. Membrane connecting digits.

Wolfian body. The mesonephros, or permanent kidney.

Xiphiplastra. Last pair of large median bones forming plastron.

Xiphisternum. Cartilaginous plate at tip of sternum.

Zygapophyses. Points of bone affording more or less definite articulation to the vertebræ.



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Alopias vulpes.

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Isurus dekayi.

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Lamna cornubica.

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Cetorhinus maximus.

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Cynals canis.

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Galeocерdo tigrinus.

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Carcharhinus obscurus.

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Scoliodon terræ-novæ.

Pl. 74 in Rep. 1906, original, from example described on p. 63, Rep. 1905.

Cestracion tiburo.

Pl. 75 in Rep. 1906, original, from example in Bonaparte Coll. from Italy.

Cestracion zygaena.

Pl. 76 in Rep. 1906, from Storer (Pl. 38, fig. 3).

Squalus acanthias.

Upper fig. in Rep. 1905, p. 67, from Goode (Pl. 250).

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Pristis pectinatus.

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Myliobatis fremivillii.

Pl. 81 in Rep. 1906, original, from examples taken at Sea Isle City in summer of 1906 by W. J. Fox.

Rhinoptera bonasus.

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Manta birostris.

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Acipenser sturio.

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Acipenser brevirostrum.

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Psallosostomus osseus.

Pl. 83 in Rep. 1906 from Agassiz (Poiss. Foss.).

Tarpon atlanticus.

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Elops saurus.

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Etrumeus teres.

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Clupea harengus.

Fig. in Rep. 1905, p. 93, from Goode (Pl. 204).

Pomolobus medlocris.

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Lower fig. in Rep. 1905, p. 94, female, from Goode (Pl. 216b).

Pomolobus pseudoharengus.

Upper fig. in Rep. 1905, p. 96, male, from Goode (Pl. 207).

Lower fig. in Rep. 1905, p. 96, female, from Goode (Pl. 208).

Pomolobus cyanonoton.

Upper fig. in Rep. 1905, p. 98, male, from Goode (Pl. 209).

Lower fig. in Rep. 1905, p. 98, female, from Goode (Pl. 210).

Alosa sapidissima.

Upper fig. in Rep. 1905, p. 100, male, from Goode (Pl. 212).

Lower fig. in Rep. 1905, p. 100, female, from Goode (Pl. 213).

Clupanodon oglinum.

Fig. in Rep. 1906, p. 266, from De Kay (Pl. 41, fig. 132).

Brevoortia tyrannus.

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Dorosoma cepedianum.

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Anchovia eurystole.

Fig. in Rep. 1906, p. 267, from Bean (Pl. 1, fig. 1).

Anchovia brownii.

Pl. 85 in Rep. 1906, original, from examples described in Rep. 1905, p. 109.

Anchovia mitchilli.

Fig. in Rep. 1905, p. 110, from Goode (Pl. 218).

Anchovia duodecim.

Pl. 86 in Rep. 1906, original, from type.

Salvelinus fontinalis.

Pl. 8 in Rep. 1905 from Goode (Pl. 192).

Osmerus mordax.

Fig. in Rep. 1905, p. 115, from Goode (Pl. 199).

Synodus foetens.

Pl. 9 in Rep. 1905 from Jordan and Evermann (Pl. 88, fig. 236).

Anguilla chrisypa.

Fig. in Rep. 1905, p. 119, from Goode (Pl. 239).

Leptocephalus conger.

Fig. in Rep. 1905, p. 122, from Goode (Pl. 240).

Gymnothorax ocellatus.

Pl. 10 in Rep. 1905, original, from example described on p. 124.

Hybognathus nuchalis regius.

Frontispiece in Rep. 1905, original, from an example taken in the Neshaminy Creek, near Hulmeville, Bucks Co., Pa., in Sep. of 1903, by T. D. Keim and H. W. Fowler.

Pimephales notatus.

Pl. 87 in Rep. 1906, adult, original, from the Susquehanna River at York Furnace, York County, Pa., in May of 1906, taken by Witmer Stone.

Pl. 88 in Rep. 1906, young, original, secured with the above.

Semotilus bullaris.

Upper fig. in Rep. 1905, p. 131, original. An unusual variation of young with 8 branched anal rays, taken in the Pennypack Creek of the Delaware basin, near Holmesburg, Phila. Co., by H. W. Fowler.

Lower fig. in Rep. 1905, p. 131, from Goode (Pl. 228).

Fig. in Rep. 1906, p. 268, young, from Storer (Pl. 22, fig. 2).

Semotilus atromaculatus.

Fig. in Rep. 1905, p. 133, young, original, taken in the Pennypack Creek, of the Delaware basin, near Holmesburg, Phila. Co., Pa., by H. W. Fowler.

Pl. 89 in Rep. 1906, from Goode (Pl. 228).

Leuciscus vandoisulus.

Fig. in Rep. 1906, p. 269, from Cope (Trans. Amer. Philos. Soc. Phila., XIII, 1869, Pl. 13, fig. 2).

Leuciscus margarita.

Fig. in Rep. 1906, p. 269, from Cope (Trans. Amer. Philos. Soc., XIII, 1869, Pl. 13, fig. 1).

Brama crysoleucas.

Fig. in Rep. 1905, p. 136, young, original, taken in the Pennypack Creek at Holmesburg, Phila. Co., Pa.

Fig. in Rep. 1905, p. 137, from Goode (Pl. 227).

[*Brama crysoleucas versicolor* not figured.]

Notropis bifrenatus.

Pl. 11 in Rep. 1905, original, from an example taken in the Pennypack Creek, of the Delaware basin, at Holmesburg, Phila. Co., Pa., by H. W. Fowler.

Notropis procne.

Pl. 12 in Rep. 1905, original, from an example taken in the Pennypack Creek, of the Delaware basin, at Holmesburg, Phila. Co., Pa., by H. W. Fowler.

Notropis hudsonius amarus.

Fig. in Rep. 1906, p. 271, from Cope (Trans. Amer. Philos. Soc. Phila., XIII, 1869, Pl. 12, fig. 3).

Notropis analostanus.

Fig. in Rep. 1906, p. 272, from Cope (Trans. Amer. Philos. Soc. Phila., XIII, 1869, Pl. 11, fig. 3).

Notropis cornutus.

Fig. in Rep. 1906, p. 273, from Storer (Pl. 21, fig. 3).

Notropis chalybæus.

Fig. in Rep. 1905, p. 145, original (from Proc. Acad. Nat. Sci. Phila., 1904, Pl. 17, lower figure).

Notropis chalybæus abbotti.

Fig. in Rep. 1905, p. 147, original (from Proc. Acad. Nat. Sci. Phila., 1904, Pl. 17, upper figure).

Notropis photogenis amœnus.

Fig. in Rep. 1905, p. 148, young, original, from an example taken in the Neshaminy Creek, near Hulmeville, Bucks Co., Pa., in Sept. 1904, by T. D. Keim and H. W. Fowler.

Rhinichthys cataractæ.

Fig. in Rep. 1906, p. 275, from Storer (Pl. 22, fig. 1).

Rhinichthys atronasus.

Fig. in Rep. 1906, p. 276, from Storer (Pl. 21, fig. 4).

Hybopsis kentuckiensis.

Fig. in Rep. 1905, p. 153, from Goode (Pl. 229).

Pl. 90 in Rep. 1906, young, original, from an example taken in the Susquehanna River at York Furnace, York Co., Pa., in May of 1906, by H. W. Fowler.

Exoglossum maxilllingua.

Pl. 13 in Rep. 1905, original, from an example taken in the Red Clay Creek near Mendenhall, in the Brandywine drainage of the Delaware basin, Chester Co., Pa., on April 15th, 1904, by Alfred Satterthwait and H. W. Fowler.

Catostomus commersonii.

Fig. in Rep. 1905, p. 156, young, original, from young example taken in the Pennypack Creek at Holmesburg, Phila. Co., Pa., by H. W. Fowler.

Fig. in Rep. 1905, p. 157, from Goode (Pl. 223).

Catostomus nigricans.

Pl. 91 in Rep. 1906, original, from example described on p. 158, Rep. 1905.

Ermlyzon sucetta oblongus.

Fig. above in Rep. 1905, p. 160, young, original, from an example taken in the Pennypack Creek at Holmesburg, Phila. Co., Pa., by H. W. Fowler.

Fig. below in Rep. 1905, p. 160, adult, from Goode (Pl. 220).

Fig. in Rep. 1906, p. 277, young, from Bean (Pl. 1, fig. 20).

Moxostoma macrolepidotum.

Fig. in Rep. 1905, p. 163, from Goode (Pl. 222a).

Felichthys marinus.

Pl. 14 in Rep. 1905, from Goode (Pl. 235).

Amelurus catus.

Fig. in Rep. 1905, p. 167, from Goode (Pl. 232).

Amelurus natalis prosthius.

Pl. 92 in Rep. 1906, originals, from type described on p. 167 in Rep. 1905.

Amelurus nebulosus.

Fig. in Rep. 1905, p. 169, from Goode (Pl. 233).

Schilbeodes gyrinus.

Fig. in Rep. 1906, p. 279, original from example taken in the Pennypack Creek at Holmesburg, Phila. Co., Pa., by H. W. Fowler.

Schilbeodes insignis.

Pl. 15 in Rep. 1905, from Jordan and Evermann (Pl. 28, fig. 66).

Esox americanus.

Pl. 33 in Rep. 1906, from Holbrook (Ich. S. C., Pl. "27" [28] figs. 2).

Esox reticulatus.

Fig. in Rep. 1905, p. 179, from Goode (Pl. 183).

Fig. in Rep. 1906, p. 280, young, from Bean (Pl. 1, fig. 17).

Umbra pygmæa.

Pl. 16 in Rep. 1905, from Jordan & Evermann (Pl. 99, fig. 268).

Fundulus majalis.

Fig. of young in Rep. 1905, p. 185, from Jordan and Evermann (Pl. 101, fig. 271b).

Fig. of female in Rep. 1905, p. 187, from Goode (Pl. 185).

Fig. of male in Rep. 1906, p. 281, original, from Sea Isle City, July 21st, 1906, by W. J. Fox and H. W. Fowler.

Fundulus heteroclitus macrolepidotus.

Pl. 17 in Rep. 1905, from Jordan and Evermann (Pl. 102, fig. 273).

Fundulus diaphanus.

Fig. in Rep. 1905, male, p. 194, from Jordan and Evermann (Pl. 103, fig. 275).

Fig. in Rep. 1905, female, p. 195, from Jordan and Evermann (Pl. 103, fig. 275a).

Zygonectes luciae.

Pl. 18 in Rep. 1905, from Jordan and Evermann (Pl. 107, fig. 286).

Lucania parva.

Fig. in Rep. 1906, p. 283, from Bean (Pl. 2, fig. 18).

Cyprinodon variegatus.

Fig. in Rep. 1905, p. 199, male, from Jordan and Evermann (Pl. 111, fig. 296).

Fig. in Rep. 1905, p. 200, young, from Jordan and Evermann (Pl. 112, fig. 296a).

Tylosurus marinus.

Fig. in Rep. 1905, p. 204, from Goode (Pl. 181).

Tylosurus raphidoma.

Pl. 19 in Rep. 1905, from Jordan and Evermann (Pl. 116, fig. 308).

Fig. in Rep. 1906, p. 285, young, from Bean (Pl. 2, fig. 15).

Scombresox saurus.

Fig. in Rep. 1905, p. 207, from Goode (Pl. 181).

Hyporhamphus unifasciatus.

Fig. in Rep. 1905, p. 208, from Goode (Pl. 182).

Hemiramphus brasiliensis.

Fig. in Rep. 1906, p. 286, from Jordan and Evermann (Pl. 117, fig. 313).

Euleptorhamphus velox.

Pl. 94 in Rep. 1906, original, from example described in Rep. 1905, p. 209.

[Cypselurus californicus.

Fig. in Rep. 1905, p. 211, not *Cypselurus heterurus* (Rafinesque), from Goode (Pl. 182).]

Cypselurus furcatus.

Fig. in Rep. 1906, p. 288, from Le Sueur (Journ. Acad. Nat. Sci. Phila., II, pt. I, 1821, Pl. 4, fig. 1).

Kirtlandia vagrans lacinata.

Pl. 95 in Rep. 1906, original, from an example collected at Ocean City, Cape May County, Aug. 30th, 1905, by P. Lorrilliere, D. McCadden and H. W. Fowler.

Menidia beryllina cerea.

Fig. in Rep. 1906, p. 288, from Kendall (Rep. U. S. F. Com., 1901 (1902), p. 261, fig. —).

Menidia menidia notata.

Fig. in Rep. 1905, p. 216, from Goode (Pl. 180).

Mugil cephalus.

Fig. in Rep. 1905, p. 218, from Goode (Pl. 179).

Mugil curema.

Fig. in Rep. 1905, p. 220, from Goode (Pl. 179).

Sphyræna barracuda.

Fig. in Rep. 1905, p. 222, from Goode (Pl. 178).

Fig. in Rep. 1906, p. 289, young, from Bean (Pl. 2, fig. 14).

Sphyræna borealis.

Fig. in Rep. 1905, p. 222, from Goode (Pl. 178).

Pygosteus pungitius.

Pl. 96 in Rep. 1906, original, from example described in Rep. 1905, p. 224.

Gasterosteus bispinosus.

Pl. 97 in Rep. 1906, original, from example described in Rep. 1905, p. 225.

Apeltes quadracus.

Pl. 20 in Rep. 1905, from Jordan and Evermann (Pl. 120, fig. 322).

Fistularia tabacaria.

Pl. 98 in Rep. 1906, from Storer (Pl. 25, fig. 1).

Syngnathus fuscus.

Fig. in Rep. 1906, p. 290, from Storer (Pl. 33, fig. 3).

Hippocampus hudsonius.

Pl. 21 in Rep. 1905, from Jordan and Evermann (Pl. 121, fig. 327).

Hippocampus punctulatus.

Pl. 99 in Rep. 1906, original, from an example taken at Key West, Fla., by E. Bates.

Scomber scombrus.

Fig. in Rep. 1905, p. 238, from Goode (Pl. 91).

Scomber colids.

Fig. in Rep. 1905, p. 239, from Goode (Pl. 91).

Pelamys alleterata.

Pl. 22 in Rep. 1905, from Jordan and Evermann (Pl. 134, fig. 366).

Albacora thynnus.

Fig. in Rep. 1905, p. 241, from Goode (Pl. 96).

Sarda sarda.

Fig. in Rep. 1905, p. 242, from Goode (Pl. 92).

Scomberomorus maculatus.

Fig. in Rep. 1905, p. 244, from Goode (Pl. 93).

Scomberomorus regalis.

Fig. in Rep. 1905, p. 246, from Goode (Pl. 94).

Istiophorus nigricans.

Fig. in Rep. 1906, p. 295, from Jordan and Evermann (Pl. 137, fig. 376).

Trichiurus lepturus.

Pl. 23 in Rep. 1905, from Goode (Pl. 114).

Xiphias gladius.

Figs. in Rep. 1905, p. 249, from Goode (Pl. 115).

Naucrates ductor.

Pl. 24 in Rep. 1905, from Goode (Pl. 107).

Seriola zonata.

Pl. 25 in Rep. 1905, from Jordan and Evermann (Pl. 139, fig. 381).

Seriola lalandi.

Pl. 26 in Rep. 1905, from Jordan and Evermann (Pl. 140, fig. 382).

Trachurops crumenophthalmus.

Pl. 100 in Rep. 1906, from Goode (Pl. 100).

Decapterus punctatus.

Fig. in Rep. 1905, p. 254, from Goode (Pl. 102).

Caranx hippos.

Pl. 27 in Rep. 1905, from Goode (Pl. 99).

Caranx crysos.

Fig. in Rep. 1905, p. 256, from Jordan and Evermann (Pl. 142, fig. 388).

Caranx latus.

Pl. 28 in Rep. 1905, from Jordan and Evermann (Pl. 142, fig. 389).

Blepharis crinitus.

Pl. 101 in Rep. 1906, from De Kay (Pl. 25, fig. 76).

Vomer setapinnis.

Pl. 29 in Rep. 1905, from Goode (Pl. 97).

Selene vomer.

Pl. 30 in Rep. 1905, young, from Jordan and Evermann (Pl. 144, fig. 393).

Pl. 31 in Rep. 1905, adult, from Goode (Pl. 98).

Fig. in Rep. 1905, p. 260, adult, from Goode (Pl. 98).

Chloroscombrus chrysurus.

Pl. 32 in Rep. 1905, from Jordan and Evermann (Pl. 145, fig. 394).

Trachinotus falcatus.

Pl. 33 in Rep. 1905, from Goode (Pl. 105).

Fig. in Rep. 1906, p. 306, young, from Bean (Pl. 3, fig. 5).

Trachinotus carolinus.

Pl. 34 in Rep. 1905, from Goode (Pl. 104).

Pomatomus saltatrix.

Fig. in Rep. 1905, p. 266, from Goode (Pl. 174).

Rachycentron canadus.

Fig. in Rep. 1905, p. 268, from Goode (Pl. 174).

Fig. in Rep. 1906, p. 307, young, from Bean (Pl. 2, fig. 13).

Seserinus paru.

Pl. 35 in Rep. 1905, from Goode (Pl. 110).

Poronotus triacanthus.

Fig. in Rep. 1905, p. 270, from Goode (Pl. 111).

Pallnurlchthys percliformis.

Fig. in Rep. 1905, p. 272, from Goode (Pl. 111).

Coryphaena hippurus.

Figs. in Rep. 1905, p. 273, from Goode (Pl. 109).

Aphredoderus sayanus.

Pl. 36 in Rep. 1905, from Jordan and Evermann (Pl. 122, fig. 331).

Acantharchus pomotis.

Pl. 37 in Rep. 1905, from Goode (Pl. 150).

Enneacanthus gloriosus.

Pl. 38 in Rep. 1905, from Jordan and Evermann (Pl. 158, fig. 122).

Enneacanthus obesus.

Pl. 102 in Rep. 1906, original, from pool at head of Egg Harbor River.
E. D. Cope.

Mesogonistius chætodon.

Pl. 39 in Rep. 1905, from Goode (Pl. 161).

Lepomis phenax.

Pl. 40 in Rep. 1905, original, from the type of *Apomotis phenax* Jordan.

Lepomis auritus.

Pl. 41 in Rep. 1905, from Goode (Pl. 154).

Lepomis palladius.

Pl. 42 in Rep. 1905, from Goode (Pl. 155).

Eupomotis gibbosus.

Pl. 43 in Rep. 1905, from Goode (Pl. 153).

Perca flavescens.

Pl. 44 in Rep. 1905, from Goode (Pl. 168).

Percina caprodes.

Pl. 45 in Rep. 1905, from Jordan and Evermann (Pl. 165, fig. 436).

Boleosoma nigrum olmstedii.

Pl. 46 in Rep. 1905, from Jordan and Evermann (Pl. 171, fig. 451).

Boleichthys fusiformis erochrous.

Pl. 47 in Rep. 1905, from Jordan and Evermann (Pl. 177, fig. 469).

Roccus lineatus.

Pl. 48 in Rep. 1905, from Goode (Pl. 170).

Morone americana.

Pl. 49 in Rep. 1905, from Goode (Pl. 173).

Epinephelus morio.

Pl. 50 in Rep. 1905, from Goode (Pl. 164).

Centropristis striatus.

Pl. 51 in Rep. 1905, from Goode (Pl. 162).

Fig. in Rep. 1906, p. 316, young, from Bean (Pl. 3, fig. 12).

Eudulus auriga.

Pl. 103 in Rep. 1906, from Cuvier (Hist. Nat. Poiss., Atlas I, Pl. 52).

Pseudopriacanthus altus.

Pl. 52 in Rep. 1905, from Jordan and Evermann (Pl. 195, fig. 512).

Lobotes surinamensis.

Pl. 53 in Rep. 1905, from Goode (Pl. 175).

Lutianus griseus.

Pl. 104 in Rep. 1906, from Evermann and Marsh (Bull. U. S. F. C., 1899 (1900), Pl. 17).

Lutianus blackfordii.

Pl. 54 in Rep. 1905, from Goode (Pl. 141).

Hæmulon plumieri.

Pl. 55 in Rep. 1905, from Goode (Pl. 144).

Anisotremus virginicus.

Pl. 56 in Rep. 1905, from Jordan and Evermann (Pl. 209, fig. 539).

Orthopristis chrysopterus.

Pl. 57 in Rep. 1905, from Goode (Pl. 146).

Fig. in Rep. 1906, p. 317, young, from Bean (Pl. 3, fig. 11).

Stenotomus chrysops.

Pl. 58 in Rep. 1905, from Goode (Pl. 133).

Lagodon rhomboides.

Pl. 59 in Rep. 1905, from Goode (Pl. 138).

Archosargus probatocephalus.

Pl. 60 in Rep. 1905, adult, from Goode (Pl. 131).

Pl. 61 in Rep. 1905, young, from Goode (Pl. 130).

Fig. in Rep. 1906, p. 321, young, from Bean (Pl. 3, fig. 10).

Eucinostomus gula.

Pl. 105 in Rep. 1906, from Girard (U. S. Mex. Bound. Surv., Ich., 1859, Pl. 9, fig. 10).

Mullus auritus.

Pl. 62 in Rep. 1905, from Jordan and Evermann (Pl. 132, fig. 360).

Cynoscion regalis.

Fig. in Rep. 1905, p. 330, from Goode (Pl. 120, lower fig.).

Fig. in Rep. 1906, p. 322, young, from Bean (Pl. 2, fig. 6).

Cynoscion nebulosus.

Fig. in Rep. 1905, p. 331, from Goode (Pl. 120, upper fig.).

Bairdiella chrysura.

Pl. 63 in Rep. 1905, from Goode (Pl. 126).

Fig. in Rep. 1906, p. 323, young, from Bean (Pl. 1, fig. 9).

Sciaenops ocellatus.

Pl. 64 in Rep. 1905, from Goode (Pl. 125).

Lelostomus xanthurus.

Pl. 65 in Rep. 1905, from Goode (Pl. 124).

Micropogon undulatus.

Pl. 106 in Rep. 1906, from Goode (Pl. 128).

Menticirrhus americanus.

Pl. 66 in Rep. 1905, from Goode (Pl. 127b).

Menticirrhus saxatilis.

Pl. 67 in Rep. 1905, from Goode (Pl. 127a).

Figs. in Rep. 1906, p. 325, young, from Bean (Pls. 2-3, figs. 7-8).

Pogonias cromis.

Figs. in Rep. 1905, p. 338, from Goode (Pls. 121 and 122).

Lopholatilus chamaeleonticeps.

Pl. 68 in Rep. 1905, from Goode (Pl. 177).

Tautoglabrus adspersus.

Pl. 69 in Rep. 1905, from Goode (Pl. 86).

Tautoga onitis.

Pl. 70 in Rep. 1905, from Goode (Pl. 85).

Fig. in Rep. 1906, p. 328, young, from Bean (Pl. 3, fig. 3).

Chaetodipterus faber.

Pl. 71 in Rep. 1905, from Goode (Pl. 176).

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Chaetodon ocellatus.

Pl. 72 in Rep. 1905, from Bean (Pl. 1, fig. 4).

Fig. in Rep. 1906, p. 329, from Bean (Pl. 1, fig. 4).

Chaetodon striatus.

Pl. 108 in Rep. 1906, from Evermann and Marsh (Bull. U. S. F. C., 1899 (1900), Pl. 34).

Pomacanthus arcuatus.

Pl. 73 in Rep. 1905, from Jordan and Evermann (Pl. 251).

Angelichthys ciliaris.

Pl. 107 in Rep. 1906 from Evermann and Marsh (Bull. U. S. F. C., 1899 (1900), Pl. 37).

Teuthis hepatus.

Pl. 109 in Rep. 1906, from Cuvner (Hist. Nat. Poiss., Pl. 288).

Ballistes carolinensis.

Pl. 74 in Rep. 1905, from Goode (Pl. 38).

Stephanolepis hispidus.

Pl. 75 in Rep. 1905, from Jordan and Evermann (Pl. 259, fig. 635).

Alutera schœpfii.

Pl. 76 in Rep. 1905, from Jordan and Evermann (Pl. 260, fig. 636).

Lactophrys trigonus.

Figs. in Rep. 1906, p. 335, from Jordan and Evermann (Pl. 263, fig. 641, 641a).

Lagocephalus lævigatus.

Fig. in Rep. 1905, p. 362, from Goode (Pl. 36, lower fig.).

Spheroides maculatus.

Pl. 77 in Rep. 1905, from Jordan and Evermann (Pl. 264, fig. 645).

Trichodiodon pilosus.

Fig. in Rep. 1906, p. 336, from Mitchell (Trans. Lit. Philos. Soc. N. Y., I, 1815, Pl. 6, fig. 4).

Chilomycterus schœpfii.

Fig. in Rep. 1905, p. 367, from Goode (Pl. 36, upper fig.)

Mola mola.

Pl. 78 in Rep. 1905, from Goode (Pl. 35).

Sebastes marinus.

Pl. 79 in Rep. 1905, from Goode (Pl. 75).

Uranidea gracilis.

Pl. 110 in Rep. 1906, original, from an example taken at Douglassville, Berks County, Pa. S. N. Rhoads.

Myoxocephalus æneus.

Fig. in Rep. 1906, p. 337, from Jordan and Evermann (Pl. 295, fig. 716, 716a).

Myoxocephalus octodecimspinosus.

Pl. 80 in Rep. 1905, from Goode (Pl. 73, lower fig.).

Hemitripterus americanus.

Pl. 81 in Rep. 1905, from Goode (Pl. 74a).

Aspidophoroides monopterygius.

Figs. in Rep. 1905, p. 377, from Jordan and Evermann (Pl. 312, figs. 756, 756a).

Cyclopterus lumpus.

Pl. 82 in Rep. 1905, from Goode (Pl. 70).

Prionotus carolinus.

Fig. in Rep. 1905, p. 381, from Goode (Pl. 71, upper fig.).

Prionotus evolans strigatus.

Fig. in Rep. 1905, p. 382, from Goode (Pl. 71, lower fig.).

Cephalacanthus volitans.

Pl. 83 in Rep. 1905, from Jordan and Evermann (Pl. 323, fig. 778).

Gobiosoma bosci.

Pl. 111 in Rep. 1906, original, taken from *Merganser americanus*, killed in Chesapeake Bay. D. McCadden.

Echenels alba-cauda.

Pl. 84 in Rep. 1905 from Jordan and Evermann (Pl. 329, fig. 796).

Remora remora.

Pl. 112 in Rep. 1906, original, from an example from Italy.

Lophopsetta maculata.

Pl. 85 in Rep. 1905, from Jordan and Evermann (Pl. 382, fig. 938).

Etropus microstomus.

Pl. 113 in Rep. 1906, original, from an example presented by the U. S. Nat. Mus. obtained at Ocean City.

Hippoglossus hippoglossus.

Pl. 86 in Rep. 1905, from Goode (Pl. 54).

Paralichthys dentatus.

Pl. 87 in Rep. 1905, from Goode (Pl. 42).

Limanda ferruginea.

Pl. 88 in Rep. 1905, from Goode (Pl. 49).

Pseudopleuronectes americanus.

Pl. 89 in Rep. 1905, from Goode (Pl. 44).

Achirus fasciatus.

Pl. 90 in Rep. 1905, from Goode (Pl. 41).

Astroscopus guttatus.

Pl. 91 in Rep. 1905, from Goode (Pl. 69, lower fig.).

Pl. 114 in Rep. 1906, from Abbott (Proc. Acad. Nat. Sci. Phila., 1860, Pl. 7).

Upper fig. in Rep. 1906, p. 342, from Abbott (l. c.).

Two lower figs. in Rep. 1906, p. 342, young, from Bean (Pl. 1, figs. 1-2).

Blennius fucorum.

Fig. in Rep. 1906, p. 343, from Valenciennes (Hist. Nat. Poiss., Pl. 324, lower fig.).

Hypleurochilus geminatus.

Pl. 115 in Rep. 1906, original, from an example found in oyster shell from Chincoteague, Va., by Dr. C. C. Abbott.

Pholis gunnellus.

Pl. 92 in Rep. 1905, from Jordan and Evermann (Pl. 342, fig. 832).

Anarhichas lupus.

Fig. in Rep. 1905, p. 405, from Goode (Pl. 69, upper fig.).

Zoarces anguillaris.

Fig. in Rep. 1905, p. 407, from Goode (Pl. 67, upper fig.).

Rissola marginata.

Fig. in Rep. 1905, p. 408, from Goode (Pl. 66, upper fig.).

Ammodytes americanus.

Fig. in Rep. 1905, p. 410, from Goode (Pl. 66, middle fig.).

Opeanus tau.

Pl. 116 in Rep. 1906, adult, from Storer (Pl. 19, fig. 2).

Fig. in Rep. 1906, p. 343, young, from Storer (Pl. 19, fig. 1).

Pollachius virens.

Pl. 117 in Rep. 1906, from Goode (Pl. 60, upper fig.).

Microgadus tomcod.

Pl. 93 in Rep. 1905, from Goode (Pl. 58b).

Gadus callarias.

Pl. 94 in Rep. 1905, from Goode (Pl. 58a).

Melanogrammus aeglefinus.

Pl. 95 in Rep. 1905, from Goode (Pl. 59a).

Lota maculosa.

Fig. in Rep. 1905, p. 417, from Goode (Pl. 61, lower fig.).

Phycis regius.

Fig. in Rep. 1905, p. 418, from Goode (Pl. 68, upper fig.).

Phycis tenuis.

Fig. in Rep. 1905, p. 420, from Goode (Pl. 62, lower fig.).

Phycis chuss.

Fig. in Rep. 1905, p. 420, from Goode (Pl. 62, upper fig.).

Brosmo brosmo.

Fig. in Rep. 1905, p. 422, from Goode (Pl. 61, upper fig.).

Merluccius bilinearis.

Fig. in Rep. 1905, p. 423, from Goode (Pl. 65, lower fig.).

Lopholophus piscatorius.

Pl. 96 in Rep. 1905, from Goode (Pl. 60).

Pterophryne histrio.

Pl. 118 in Rep. 1906, from Storer (Pl. 18).

Cyprinus carpio.

Pl. 97 in Rep. 1905, from Goode (Pl. 230).

Carassius auratus.

Pl. 98 in Rep. 1905, from Goode (Pl. 231).

Ictalurus punctatus.

Fig. in Rep. 1906, p. 349, from Jordan and Evermann (Pl. 25, fig. 58).

Ameiurus lacustris.

Fig. in Rep. 1906, p. 349, from De Kay (Pl. 52, fig. 170).

Oncorhynchus tshawytscha.

Fig. in Rep. 1905, p. 432, from Goode (Pl. 186, lower fig.).

Salmo salar.

Fig. in Rep. 1905, p. 433, from Goode (Pl. 186, upper fig.).

Salmo fario.

Pl. 119 in Rep. 1906, from Agassiz (Poiss. Eur. Central, 1839, Pl. 3).

Salvelinus alpinus.

Pl. 120 in Rep. 1906, from Smitt (Hist. Scand. Fish., Ed. 2, 1895, Pl. 38, figs. 1-2).

Esox masquillongy.

Pl. 121 in Rep. 1906, from Goode (Pl. 184, lower fig.).

Pomoxis annularis.

Pl. 122 in Rep. 1906, from Goode (Pl. 160).

Pomoxis sparoides.

Pl. 99 in Rep. 1905, from Goode (Pl. 159).

Ambloplites rupestris.

Pl. 100 in Rep. 1905, from Goode (Pl. 149).

Micropterus dolomieu.

Pl. 101 in Rep. 1905, from Goode (Pl. 148).

Micropterus salmoides.

Pl. 102 in Rep. 1905, from Goode (Pl. 147).

[Stizostedion canadense.

Pl. 103 in Rep. 1905, from Goode (Pl. 169, upper figure.) Wrongly identified as *Stizostedion vitreum*].

[Roccus chrysops not figured.]

Cryptobranchus alleganiensis.

Pl. 1 in Rep. 1906, from Harlan (Med. Phys. Res., 1835, opposite p. 177).
Figs. in Rep. 1906, p. 37, from Cope (p. 39, fig. 5).

Ambystoma opacum.

Pl. 2 in Rep. 1906, from Holbrook (Ed. 2, V, 1842, Pl. 23).
Figs. in Rep. 1906, p. 39, from Cope (p. 55, fig. 8).

Ambystoma punctatum.

Pl. 3 in Rep. 1906, from Holbrook (Ed. 2, V, 1842, Pl. 22).
Figs. in Rep. 1906, pp. 42 and 43, from Cope (p. 60, fig. 9 and Pl. 18).

Ambystoma conspersum.

Pl. 4 in Rep. 1906, original, from type.
Figs. in Rep. 1906, p. 44, from Cope (p. 62, fig. 10).

Ambystoma bicolor.

Pl. 5 in Rep. 1906, original, from type.

Ambystoma tigrinum.

Pl. 6 in Rep. 1906, from Holbrook (Ed. 2, V, 1842, Pl. 26).
Figs. in Rep. 1906, p. 47, from Cope (p. 68, fig. 12).

Ambystoma jeffersonianum.

Pl. 7 in Rep. 1906, from Holbrook (Ed. 2, V, 1842, Pl. 14).
Figs. in Rep. 1906, p. 51, from Cope (p. 91, fig. 15).

Hemidactylum scutatum.

Pl. 8 in Rep. 1906, original, from an example obtained at Swartzwood Lake, Warren County. S. N. Rhoads.
Figs. in Rep. 1906, p. 52, from Cope (p. 131, fig. 29).

Plethodon erythronotus.

Pl. 9 in Rep. 1906, original, from an example obtained at Kinkora Creek, Burlington County, by Dr. C. C. Abbott, T. D. Keim and H. W. Fowler.
Figs. in Rep. 1906, p. 55, from Cope (p. 136, fig. 30).

Plethodon glutinosus.

Pl. 10 in Rep. 1906, from Holbrook (Ed. 2, V, 1842, Pl. 10).
Figs. in Rep. 1906, p. 60, from Cope (p. 141, fig. 31).

Gyrinophilus porphyriticus.

Pl. 11 in Rep. 1906, from Holbrook (Ed. 2, V, 1842, Pl. 28).
Figs. in Rep. 1906, p. 62, from Cope (p. 156, fig. 37).

Spelerpes bislineatus.

Pl. 12 in Rep. 1906, from Holbrook (Ed. 2, V, 1842, Pl. 16).
Figs. in Rep. 1906, p. 64, from Cope (p. 166, fig. 40).

Spelerpes longicauda.

Pl. 13 in Rep. 1906, from Holbrook (Ed. 2, V, 1842, Pl. 19).
Figs. in Rep. 1906, p. 67, from Cope (169, fig. 41).

Spelerpes ruber.

Pl. 14 in Rep. 1906, original, from an example obtained at Bacon Hill, Cecil County, Md., February 10th, 1907, by A. H. Grosh and H. W. Fowler.
Figs. in Rep. 1906, p. 70, from Cope (p. 174, fig. 43).
Figs. in Rep. 1906, p. 72, from Holbrook (Ed. 2, V, 1842, Pl. 319).

Desmognathus fusca.

Pl. 15 in Rep. 1906, original, from examples obtained at Gold, Potter County, Pa., June of 1906, by T. D. Keim and H. W. Fowler. (Published previously in Proc. Acad. Nat. Sci. Phila., 1906, Pl. 13).
Fig. in Rep. 1906, p. 75, from Cope (p. 195, fig. 48).

Diemictylus viridescens.

- Pl. 16 in Rep. 1906, from Holbrook (Ed. 2, V, 1842, Pl. 25).
 Pl. 17 in Rep. 1906, from Holbrook (Ed. 2, V, 1842, Pl. 17).
 Figs. in Rep. 1906, p. 80, from Cope (p. 210, fig. 53).
 Figs. in Rep. 1906, p. 82, from Cope (p. 208, fig. 52).

[*Bufo lentiginosus.*

- Pl. 18 in Rep. 1906, from Holbrook (Ed. 2, V, 1842, Pl. 4).
 Figs. in Rep. 1906, p. 87, from Cope (p. 285, fig. 70).]

Scaphiopus holbrookii.

- Pl. 19 in Rep. 1906, from Holbrook (Ed. 2, IV, 1842, Pl. 27).
 Figs. in Rep. 1906, p. 96, from Cope (p. 300, fig. 74).

Pseudacris triseriatus.

- Pl. 20 in Rep. 1906, from Baird (U. S. Mex. Bound. Surv., II, pt. 2, 1859, Pl. 37, figs. 4, 5 and 6).
 Figs. in Rep. 1906, p. 98, from Cope (p. 343, fig. 87).

Acris gryllus crepitans.

- Pl. 21 in Rep. 1906, from Holbrook (Ed. 2, IV, 1842, Pl. 33).
 Figs. in Rep. 1906, p. 100, from Cope (p. 326, fig. 82).

Hyla pickeringii.

- Pl. 22 in Rep. 1906, original, from an example obtained at Palermo, Cape May County, April 15th, 1906, by G. Z. Hartman, T. D. Keim and H. W. Fowler.
 Figs. in Rep. 1906, p. 105, from Cope (p. 354, fig. 88).

Hyla andersonii.

- Pl. 23 in Rep. 1906, from Cope (Pl. 74, fig. 1).
 Figs. in Rep. 1906, p. 108, from Cope (p. 366, fig. 91).

Hyla versicolor.

- Pl. 24 in Rep. 1906, from Holbrook (Ed. 2, IV, 1842, Pl. 28).
 Figs. in Rep. 1906, p. 112, from Cope (p. 375, fig. 95).

Rana pipiens.

- Pl. 25 in Rep. 1906, from Holbrook (Ed. 2, IV, 1842, Pl. 22).
 Figs. in Rep. 1906, p. 116, from Cope (p. 402, fig. 100).

Rana virgatipes.

- Pl. 26 in Rep. 1906, original, from examples obtained at Mare Run, Atlantic County, by T. D. Keim and H. W. Fowler, April 23d, 1905. (Published previously in Proc. Acad. Nat. Sci. Phila., 1905, Pl. 40).

Rana catesbeiana.

- Pl. 27 in Rep. 1906, from Holbrook (Ed. 2, IV, 1842, Pl. 18).
 Figs. in Rep. 1906, p. 127, from Cope (p. 424, fig. 108).

Rana clamata.

Pl. 28 in Rep. 1906, from Holbrook (Ed. 2, IV, 1842, Pl. 21).
Figs. in Rep. 1906, p. 131, from Cope (p. 421, fig. 107).

Rana palustris.

Pl. 29 in Rep. 1906, from Holbrook (Ed. 2, IV, 1842, Pl. 95).
Figs. in Rep. 1906, p. 135, from Cope (p. 407, fig. 102).

Rana sylvatica.

Pl. 30 in Rep. 1906, from Holbrook (Ed. 2, IV, 1842, Pl. 24).
Figs. in Rep. 1906, p. 139, from Cope (p. 450, fig. 115).

Carphophlops amœnus.

Pl. 31 in Rep. 1906, from Holbrook (Ed. 2, III, 1842, Pl. 27).
Figs. in Rep. 1906, p. 146, from Cope (p. 736, fig. 151).

Regina leberis.

Pl. 32 in Rep. 1906, from Holbrook (Ed. 2, IV, 1842, Pl. 13).
Figs. in Rep. 1906, p. 148, from Cope (p. 994, fig. 265).

Natrix alpeidon.

Pl. 33 in Rep. 1906, from Holbrook (Ed. 2, IV, 1842, Pl. 6).
Figs. in Rep. 1906, p. 150, from Cope (p. 979, fig. 251).

Elaphe obsoletus.

Pl. 34 in Rep. 1906, from Holbrook (Ed. 2, III, 1842, Pl. 19).
Figs. in Rep. 1906, p. 154, from Cope (p. 845, fig. 194).

Storeria occipito-maculata.

Pl. 35 in Rep. 1906, from Jan (Icon. Ophid., II, livr. 30, Oct. 1868, Pl. 1, fig. 2).
Figs. in Rep. 1906, p. 156, from Cope (p. 1004, fig. 269).

Storeria dekayi.

Pl. 36 in Rep. 1906, from Holbrook (Ed. 2, IV, 1842, Pl. 14).
Figs. in Rep. 1906, p. 158, from Cope (p. 1001, fig. 268).

Clonophis kirtlandii.

Pl. 37 in Rep. 1906, from Jan (Icon Ophid., II, livr. 30, Oct., 1868, Pl. 1, fig. 2).
Figs. in Rep. 1906, p. 160, from Cope (p. 996, fig. 266).
Figs. in Rep. 1906, p. 161, from Jan (l. c.).

Opheodrys aestivus.

Pl. 38 in Rep. 1906, from Holbrook (Ed. 2, IV, 1842, Pl. 3).
Figs. in Rep. 1906, p. 162, from Cope (p. 785, fig. 170).

Liopeitia vernalis.

Pl. 39 in Rep. 1906, from Holbrook (Ed. 2, III, 1842, Pl. 17).
Figs. in Rep. 1906, p. 164, from Cope (p. 782, fig. 169).

Diadophis punctatus.

Pl. 40 in Rep. 1906, from Holbrook (Ed. 2, III, 1842, Pl. 18).
Figs. in Rep. 1906, p. 166, from Cope (p. 751, fig. 162).

Bascanion constrictor.

Pl. 41 in Rep. 1906, from Holbrook (Ed. 2, III, 1842, Pl. 9).
Figs. in Rep. 1906, p. 168, from Cope (p. 791, fig. 171).

Pituophis melanoleucus.

Pl. 42 in Rep. 1906, from Holbrook (Ed. 2, IV, 1842, Pl. 1).
Figs. in Rep. 1906, p. 171, from Cope (p. 868, fig. 203).

Thamnophis sauritus.

Pl. 43 in Rep. 1906, from Holbrook (Ed. 2, IV, 1842, Pl. 4).
Figs. in Rep. 1906, p. 173, from Cope (p. 102, fig. 276).

Thamnophis sirtalis.

Pl. 44 in Rep. 1906, from Holbrook (Ed. 2, IV, 1842, Pl. 11).
Figs. in Rep. 1906, p. 176, from Cope (p. 1069, fig. 300).

Lampropeltis getulus.

Pl. 45 in Rep. 1906, from Holbrook (Ed. 2, III, 1842, Pl. 21).
Figs. in Rep. 1906, p. 179, from Cope (p. 914, fig. 227).

[*Lampropeltis dollatus.*

Pl. 46 in Rep. 1906, from Holbrook (Ed. 2, III, 1842, Pl. 15)].

Lampropeltis dollatus clericus.

Figs. in Rep. 1906, pp. 182, 183, from Cope (p. 888, fig. 212 and Pl. 32, fig. 2).

Heterodon platirhinos.

Pl. 47 in Rep. 1906, from Holbrook (Ed. 2, IV, 1842, Pl. 17).
Figs. in Rep. 1906, p. 185, from Cope (p. 764, fig. 165, and p. 762, fig. 165).

Agkistrodon contortrix.

Pl. 48 in Rep. 1906, from Holbrook (Ed. 2, III, 1842, Pl. 8).
Figs. in Rep. 1906, p. 190, from Cope (p. 1136, fig. 326).

Crotalus horridus.

Pl. 49 in Rep. 1906, from Holbrook (Ed. 2, III, 1842, Pl. 1).
Figs. in Rep. 1906, p. 192, from Cope (p. 1186, fig. 342).

Eumeces fasciatus.

Pl. 50 in Rep. 1906, from Holbrook (Ed. 2, II, 1842, Pl. 18).
Figs. in Rep. 1906, p. 195, from Cope (p. 634, fig. 125).

Liolopiama laterale.

Pl. 51 in Rep. 1906, original, from an example taken at Atsion in Burlington County, N. J., September 2d, 1901, by J. A. G. Rehn.

Figs. in Rep. 1906, p. 197, from Cope (p. 323, fig. 123).

Sceloporus undulatus.

Pl. 52 in Rep. 1906, from Holbrook (Ed. 2, II, 1842, Pl. 9).

Figs. in Rep. 1906, p. 199, from Cope (p. 372, fig. 58).

Dermochelys coriacea.

Pl. 53 in Rep. 1906, from Holbrook (Ed. 2, II, 1842, Pl. 6).

Fig. in Rep. 1906, p. 205, from Holbrook (Ed. 2, II, 1842, Pl. 6).

Caretta caretta.

Pl. 54 in Rep. 1906, from Holbrook (Ed. 2, II, 1842, Pl. 4).

Figs. in Rep. 1906, p. 208, from Agassiz (Pl. 6, figs. 13-16).

Chelonia mydas.

Pl. 55 in Rep. 1906, from Sowerby and Lear (Tort. Ter. Turt., 1872, Pl. 59).

Pl. 56 in Rep. 1906, from Sowerby and Lear (l. c., Pl. 60).

Aspidonectes spinifer.

Pl. 57 in Rep. 1906, from Holbrook (Ed. 2, II, 1842, Pl. 1).

Figs. in Rep. 1906, p. 212, from Agassiz (Pl. 6, figs. 1 and 2).

Chelydra serpentina.

Pl. 58 in Rep. 1906 from Holbrook (Ed. 2, I, 1842, Pl. 23).

Figs. in Rep. 1906, pp. 215, 217, from Agassiz (Pl. 4, figs. 13-16; Pl. 5 figs. 18-19).

Kinosternon pensylvanicum.

Pl. 59 in Rep. 1906, from Holbrook (Ed. 2, I, 1842, Pl. 21).

Figs. in Rep. 1906, pp. 221, 222, from Agassiz (Pl. 4, figs. 7-12; Pl. 5, figs. 16-17).

Terrapene odorata.

Pl. 60 in Rep. 1906, from Holbrook (Ed. 2, I, 1842, Pl. 22).

Figs. in Rep. 1906, p. 224, from Agassiz (Pl. 4, 1-6).

Graptemys geographica.

Pl. 61 in Rep. 1906, from Holbrook (Ed. 2, I, 1842, Pl. 14).

Figs. in Rep. 1906, p. 229, from Agassiz (Pl. 2, figs. 7-9).

[*Malaclemys centrata.*

Pl. 62 in Rep. 1906, from Holbrook (Ed. 2, I, 1842, Pl. 12).

Figs. in Rep. 1906, p. 231, from Agassiz (Pl. 1, figs. 10 and 12).]

Pseudemys rubriventris.

Pl. 63 in Rep. 1906, from Holbrook (Ed. 2, I, 1842, Pl. 6).

Chrysemys picta.

Pl. 64 in Rep. 1906, from Holbrook (Ed. 2, I, 1842, Pl. 10).

Figs. in Rep. 1906, pp. 236, 237, from Agassiz (Pl. 1, figs. 1-5).

Clemmys muhlenbergii.

Pl. 65 in Rep. 1906, original, from an example taken at Medford, Burlington County, N. J., May 20th, 1905, by Witmer Stone.

Clemmys insculpta.

Pl. 66 in Rep. 1906, from Holbrook (Ed. 2, I, 1842, Pl. 13).

Clemmys guttata.

Pl. 67 in Rep. 1906, from Holbrook (Ed. 2, I, 1842, Pl. 11).

Figs. in Rep. 1906, p. 245, from Agassiz (Pl. 1, figs. 7-9).

Emydoidea blandingi.

Pl. 68 in Rep. 1906, from Holbrook (Ed. 2, I, 1842, Pl. 3).

Didicla carolina.

Pl. 69 in Rep. 1906, from Holbrook (Ed. 2, I, 1842, Pl. 2).

Figs. in Rep. 1906, p. 248, from Agassiz (Pl. 4, figs. 17-19).

PLATES.

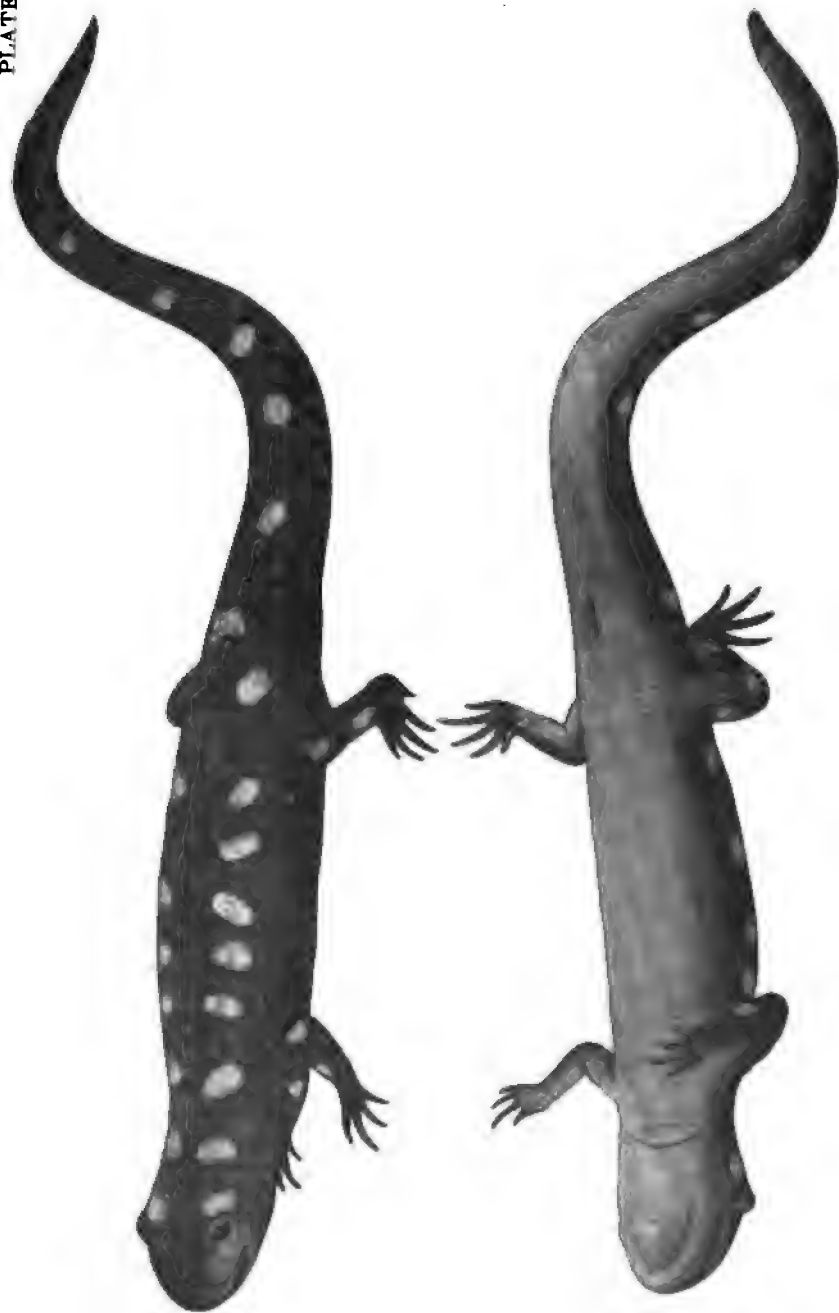
PLATE I.



HELLBENDER. *Cryptobranchus alleganiensis* (Daudin).



BLOTCHED SALAMANDER. *Ambystoma opacum* (Gravenhorst).



SPOTTED SALAMANDER. *Ambystoma punctatum* (Linnæus).

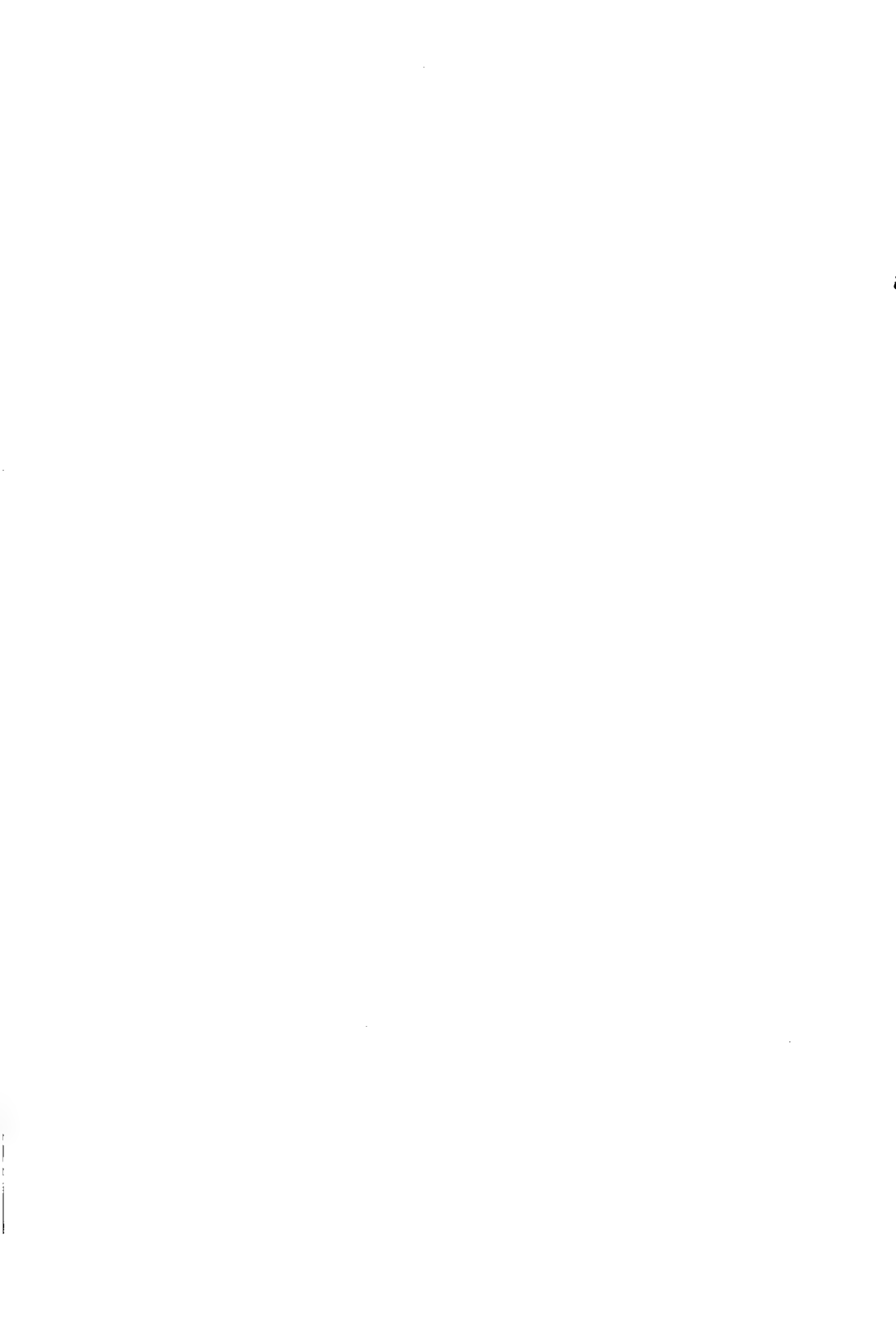
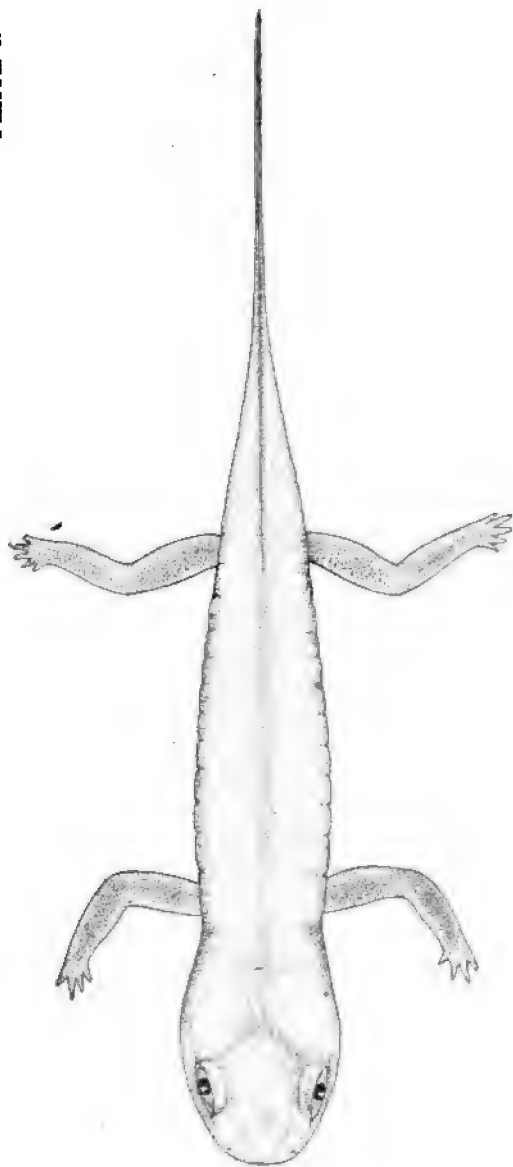
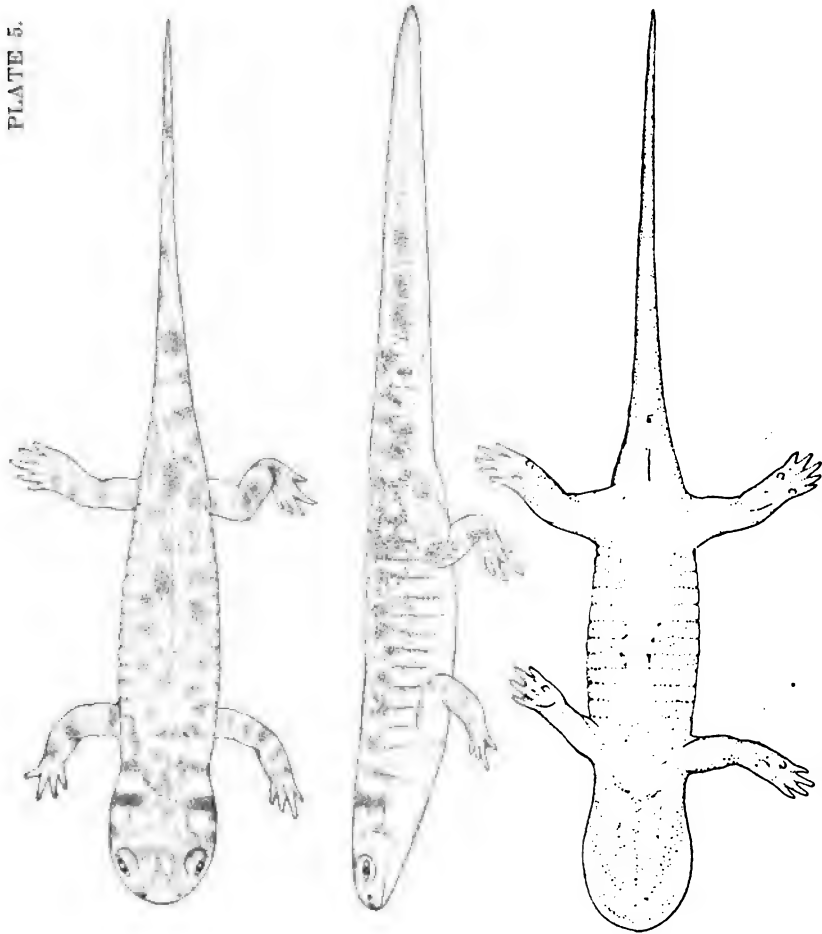


PLATE 4.

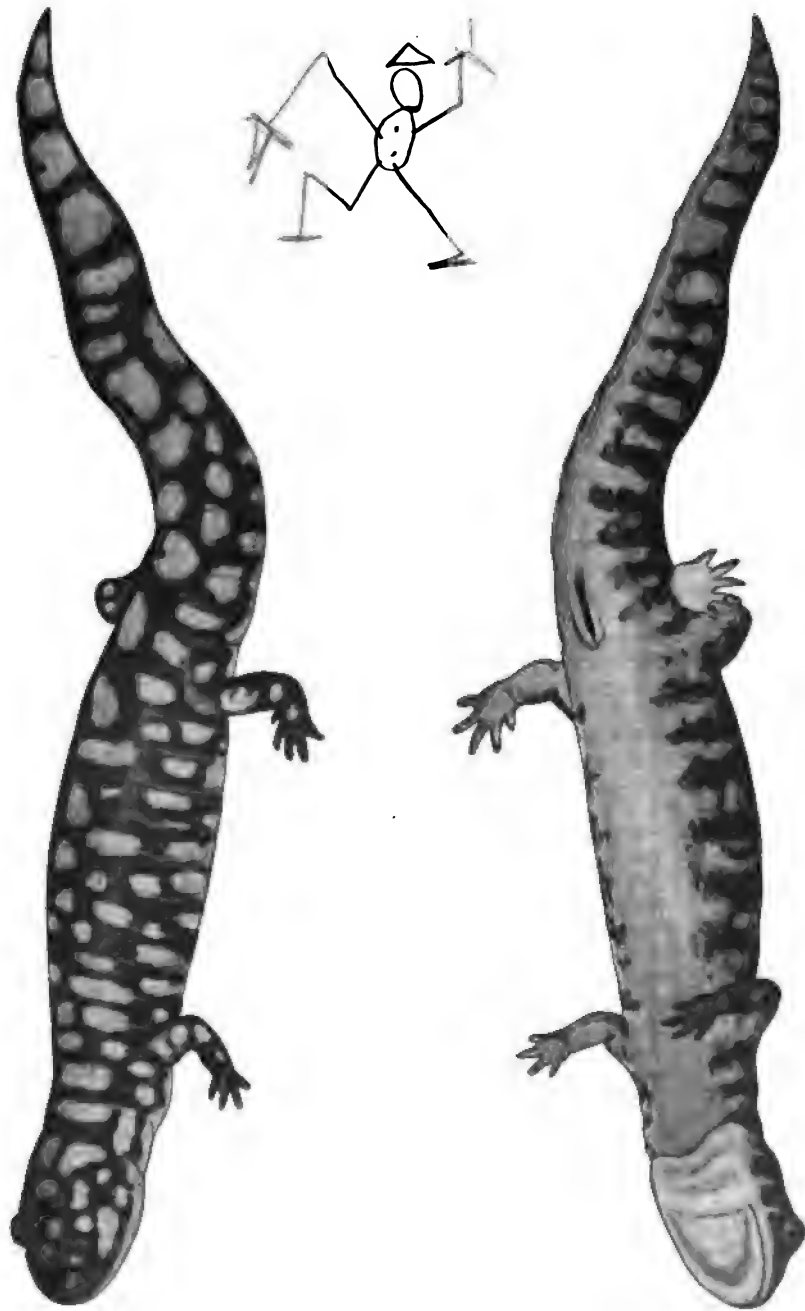


SPECKLED SALAMANDER. *Ambystoma conspersum* Cope.



RING NECKED SALAMANDER. *Ambystoma bicolor* Hallowell.

PLATE 6.

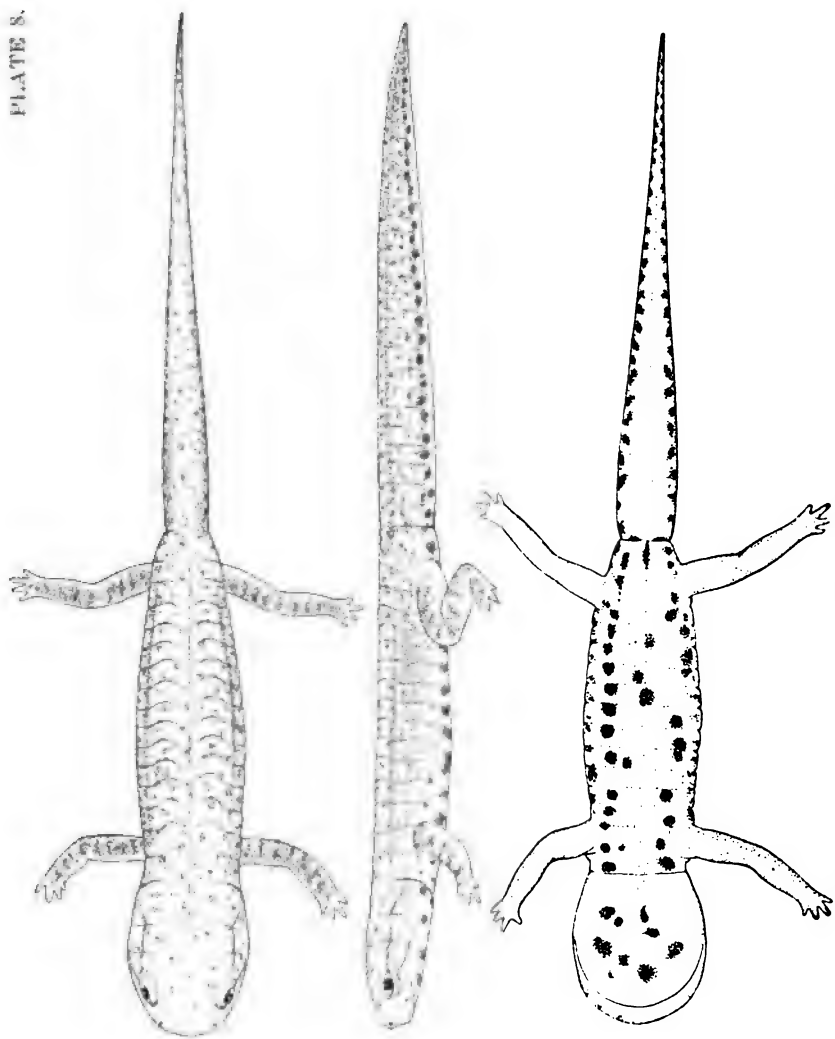


TIGER SALAMANDER. *Ambystoma tigrinum* (Green).

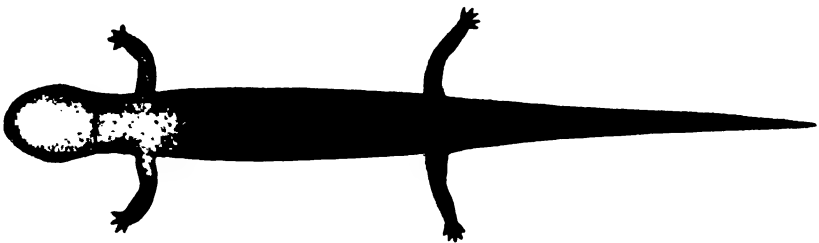
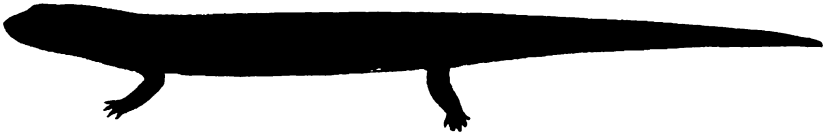
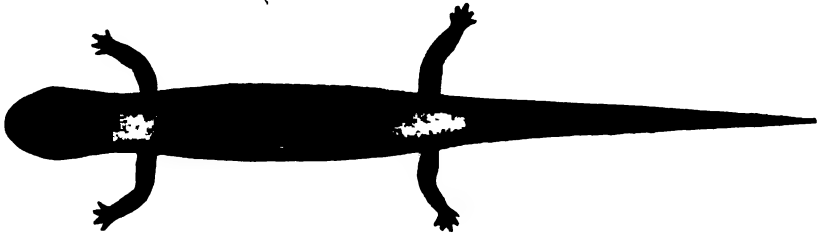
PLATE 7.



JEFFERSON'S SALAMANDER. *Ambystoma jeffersonianum* (Green).



FOUR TOED SALAMANDER. *Hemidactylium scutatum* Tschudi.

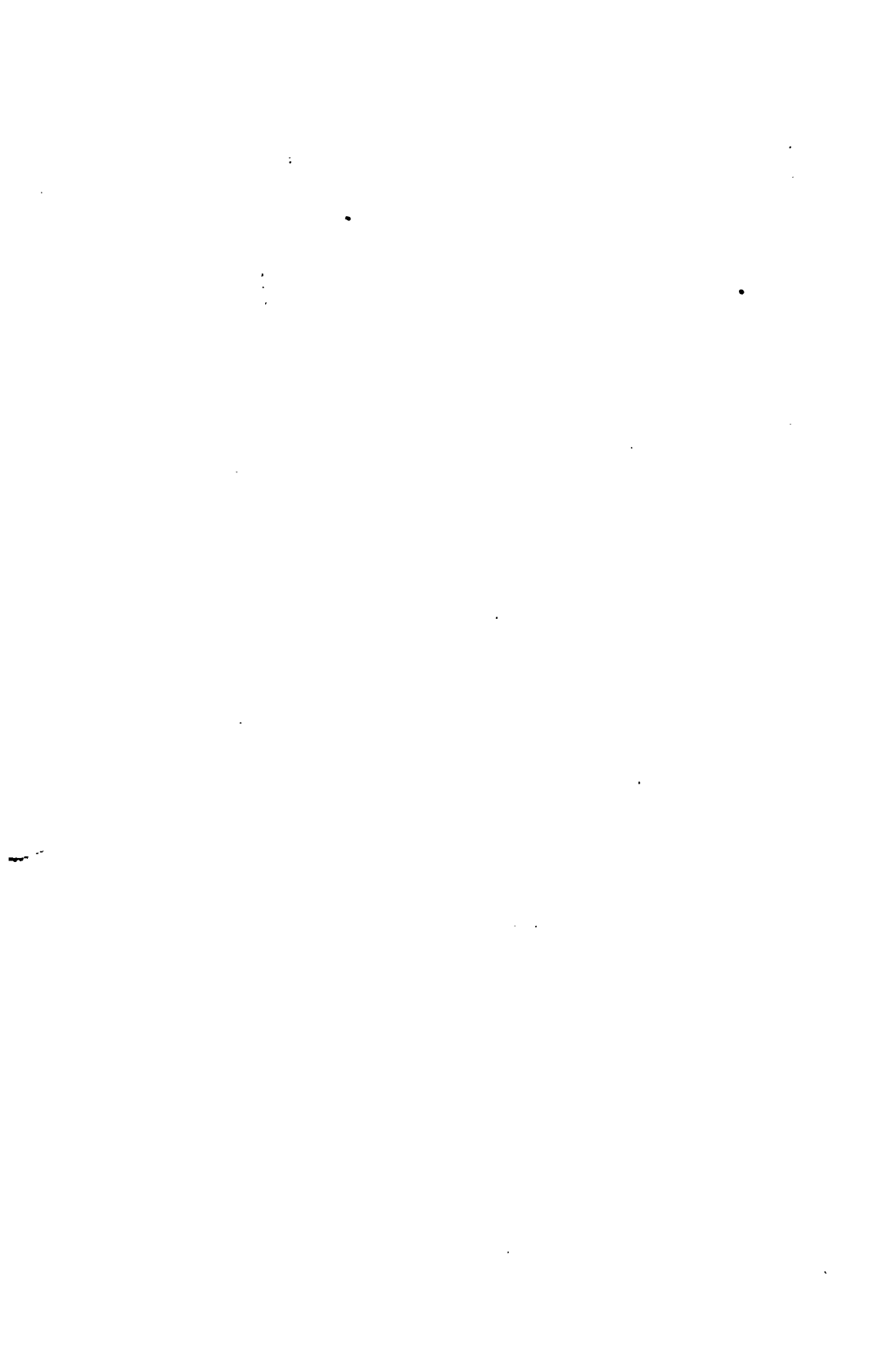


RED BACKED SALAMANDER. *Plethodon erythronotus* (Green).

PLATE 10.



STICKY SALAMANDER. *Plethodon glutinosus* (Green).

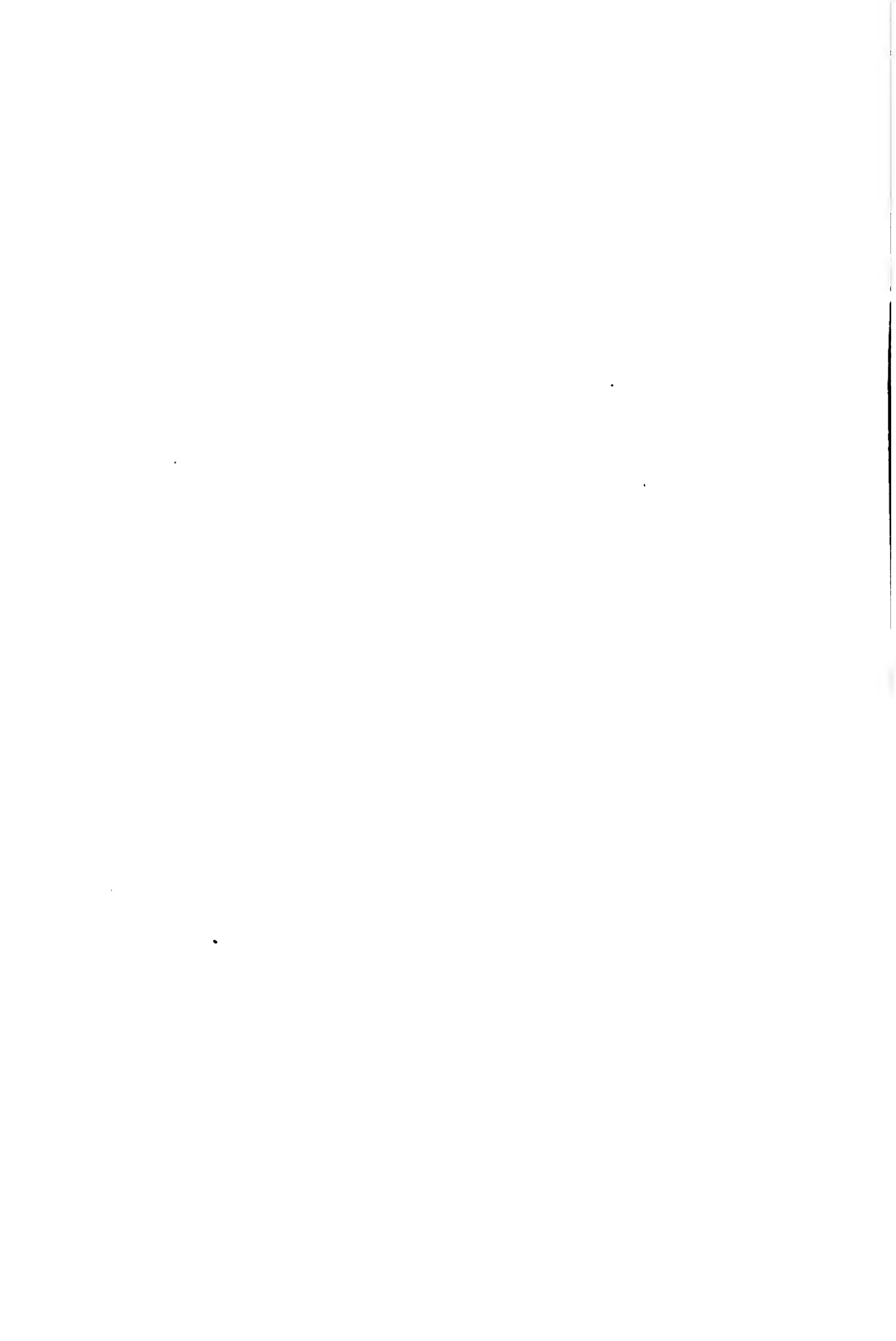


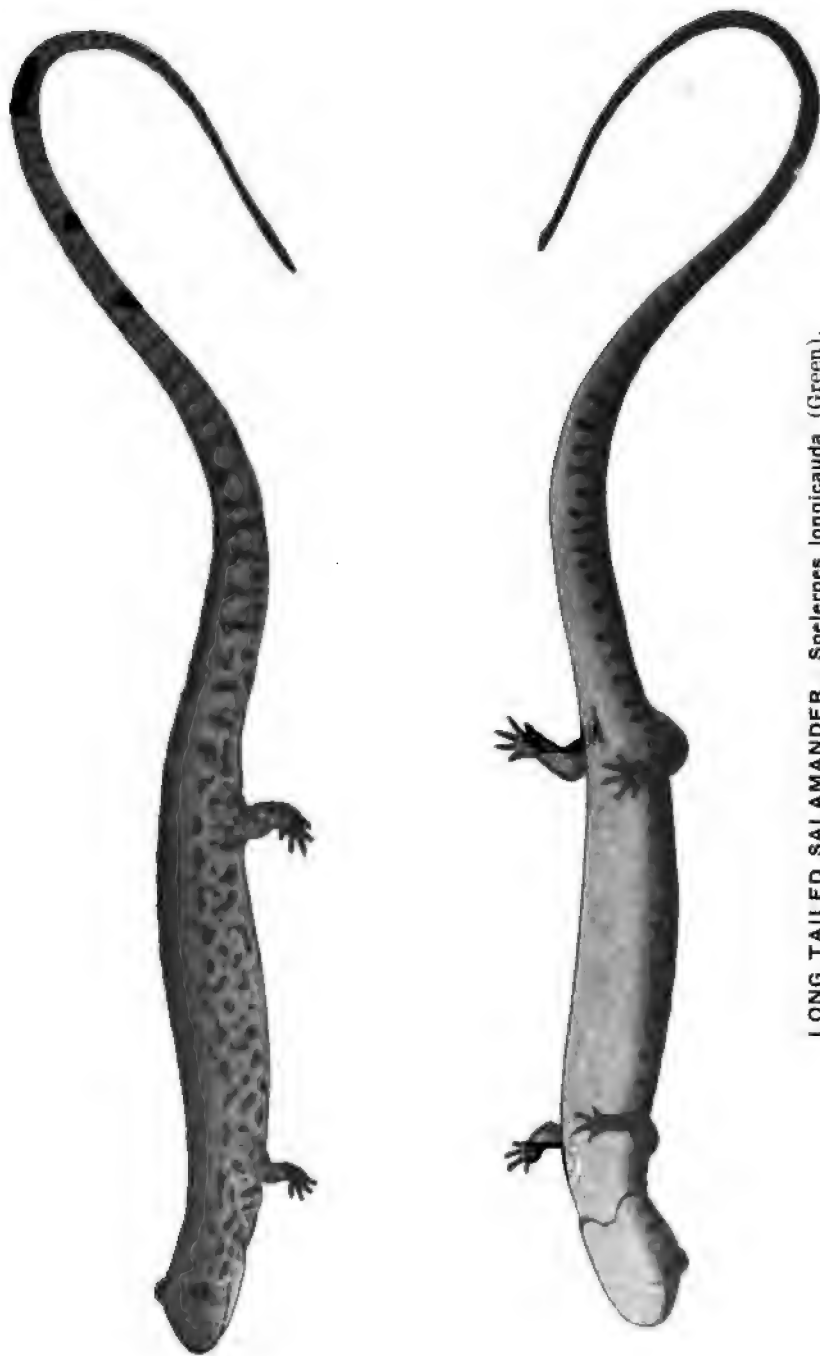


PURPLE SALAMANDER. *Gyrinophilus porphyriticus* (Green).



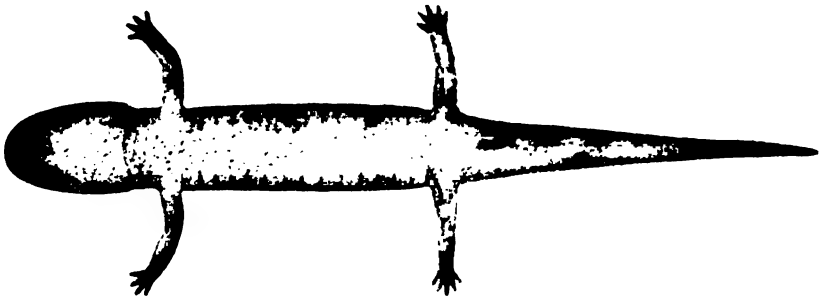
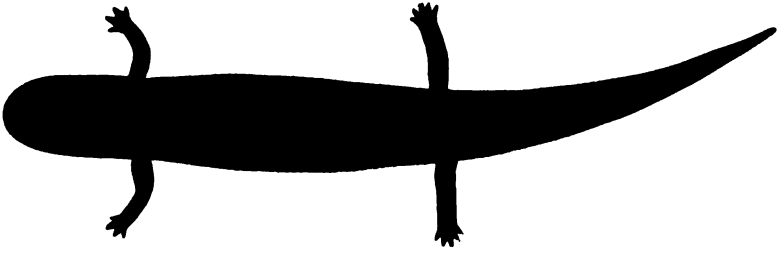
TWO LINED SALAMANDER. *Spelerpes bislineatus* (Green).



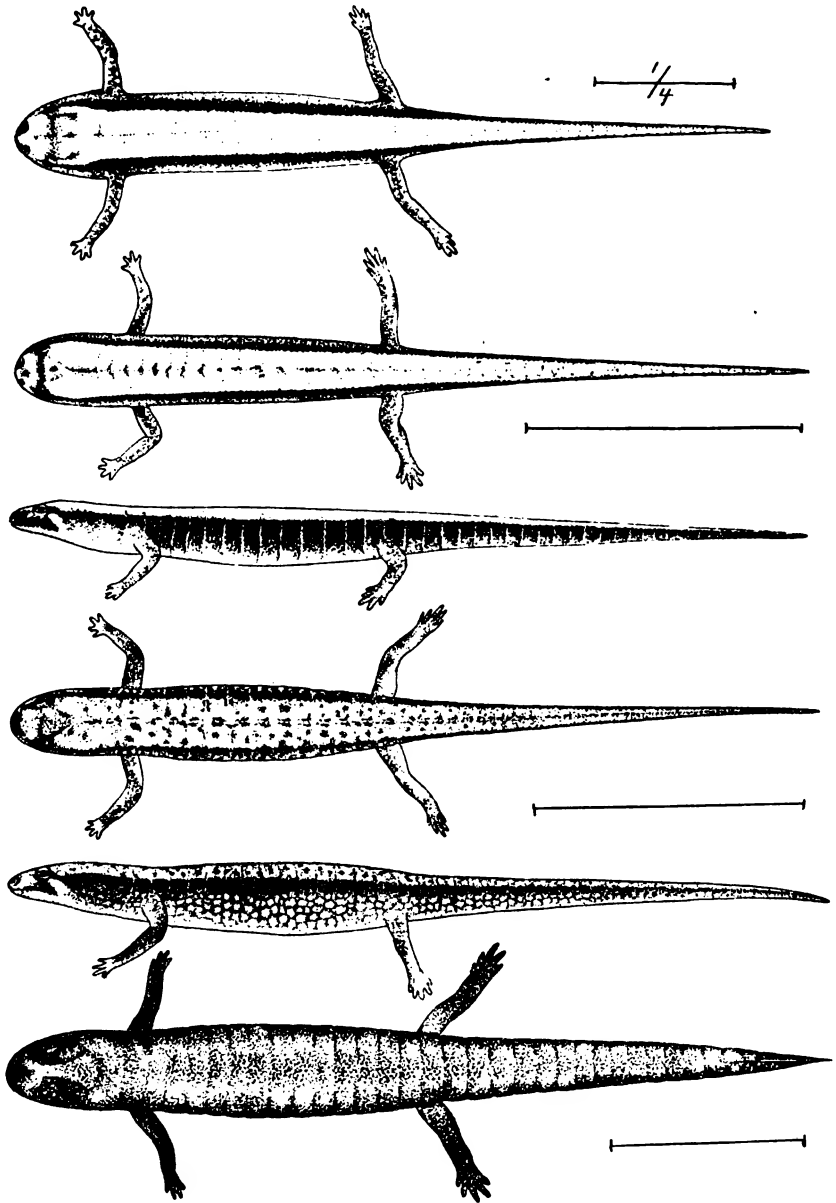


LONG TAILED SALAMANDER. *Spelerpes longicauda* (Green).

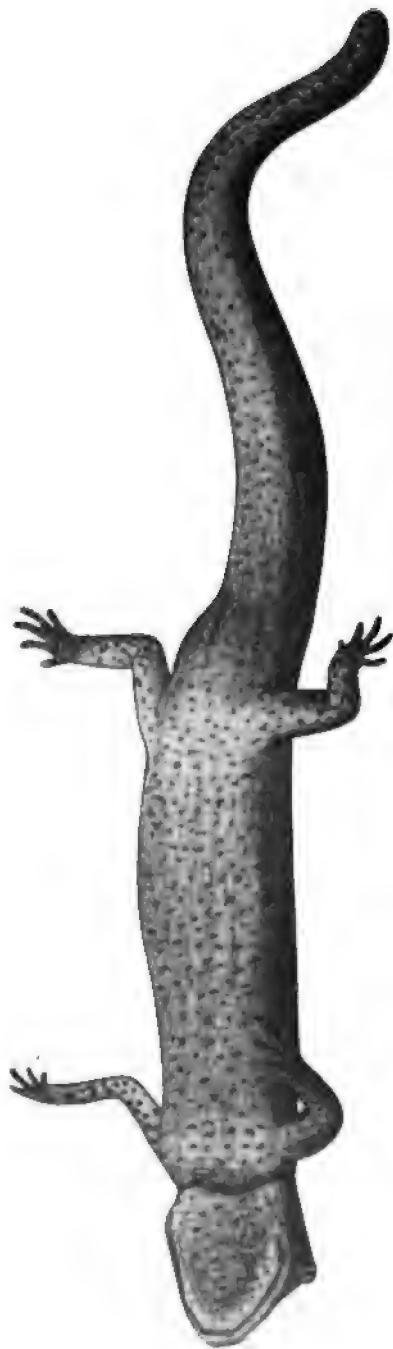




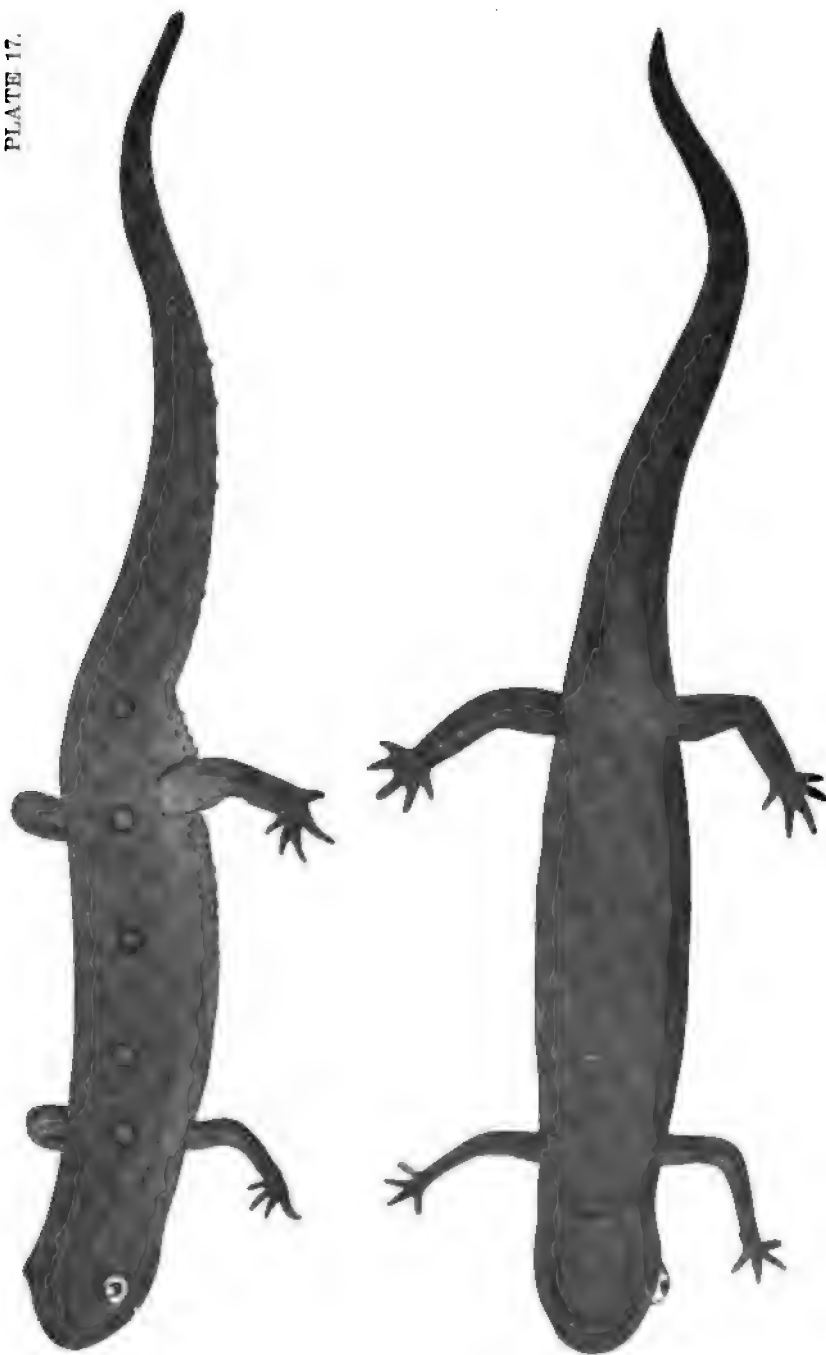
RED SALAMANDER. *Spelerpes ruber* (Daudin).



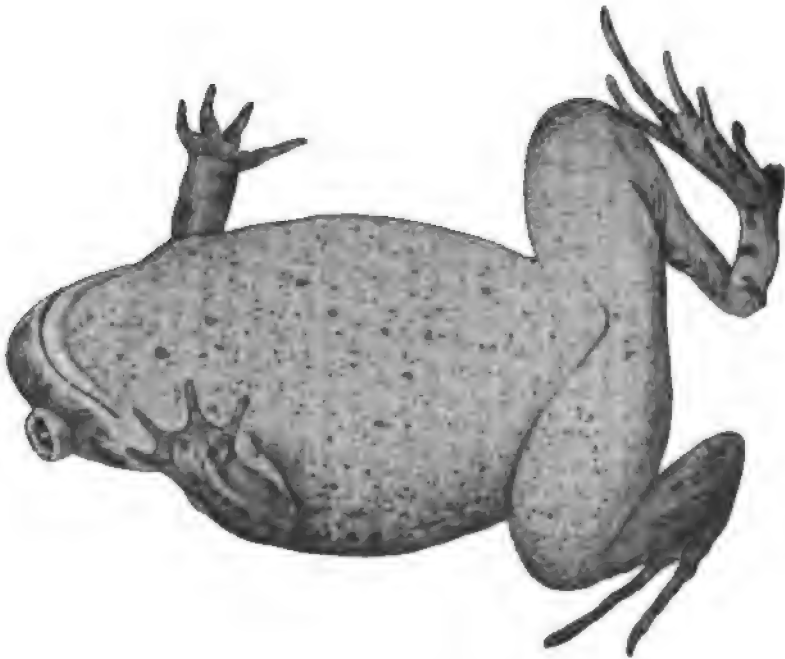
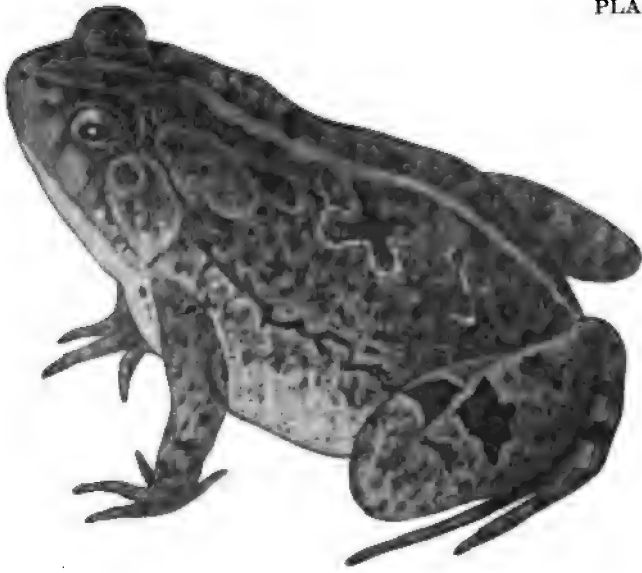
DUSKY SALAMANDER. *Desmognathus fusca* (Rafinesque).



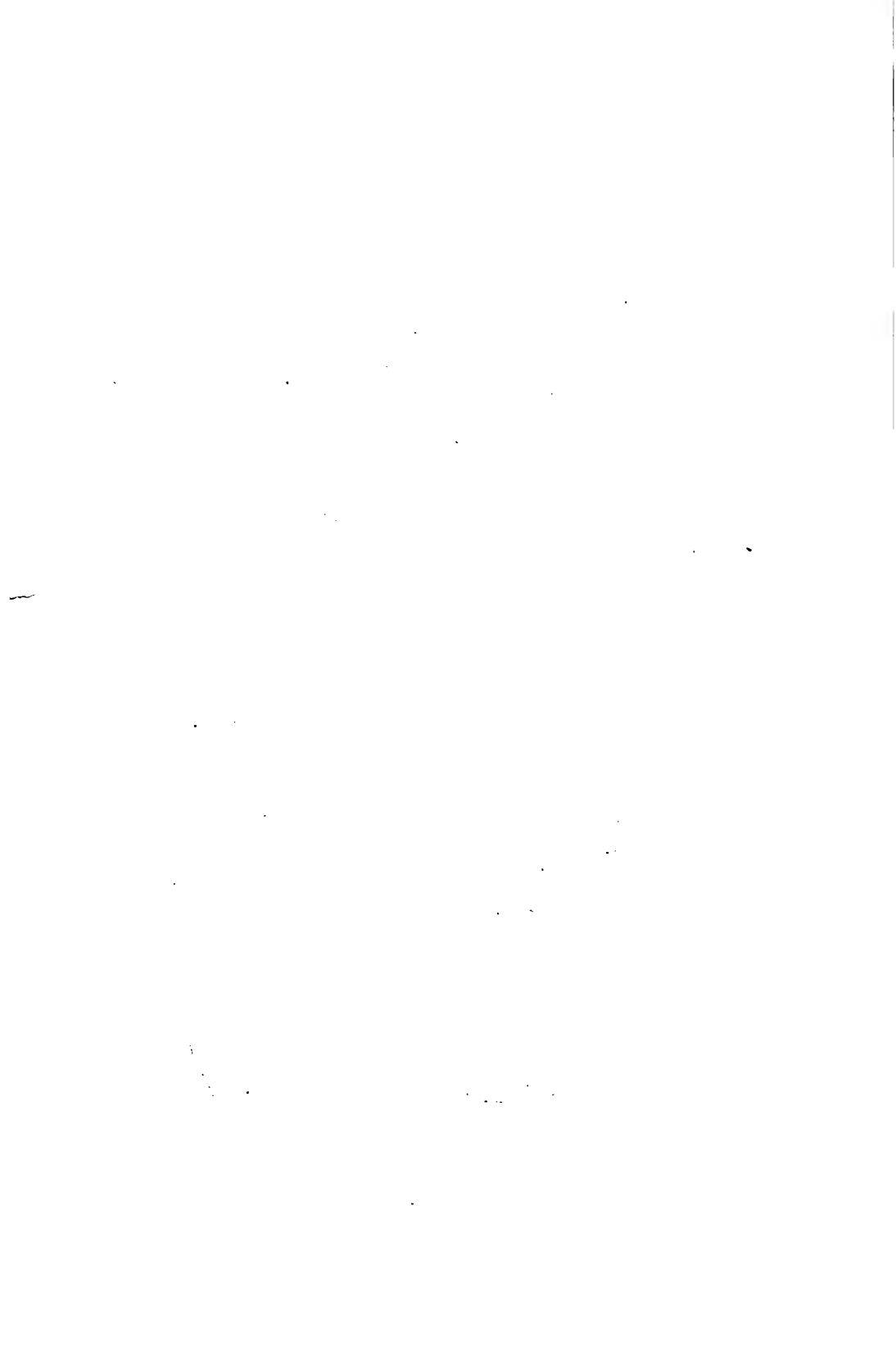
NEWT. *Diemictylus viridescens* (Rafinesque). (Aquatic form.)

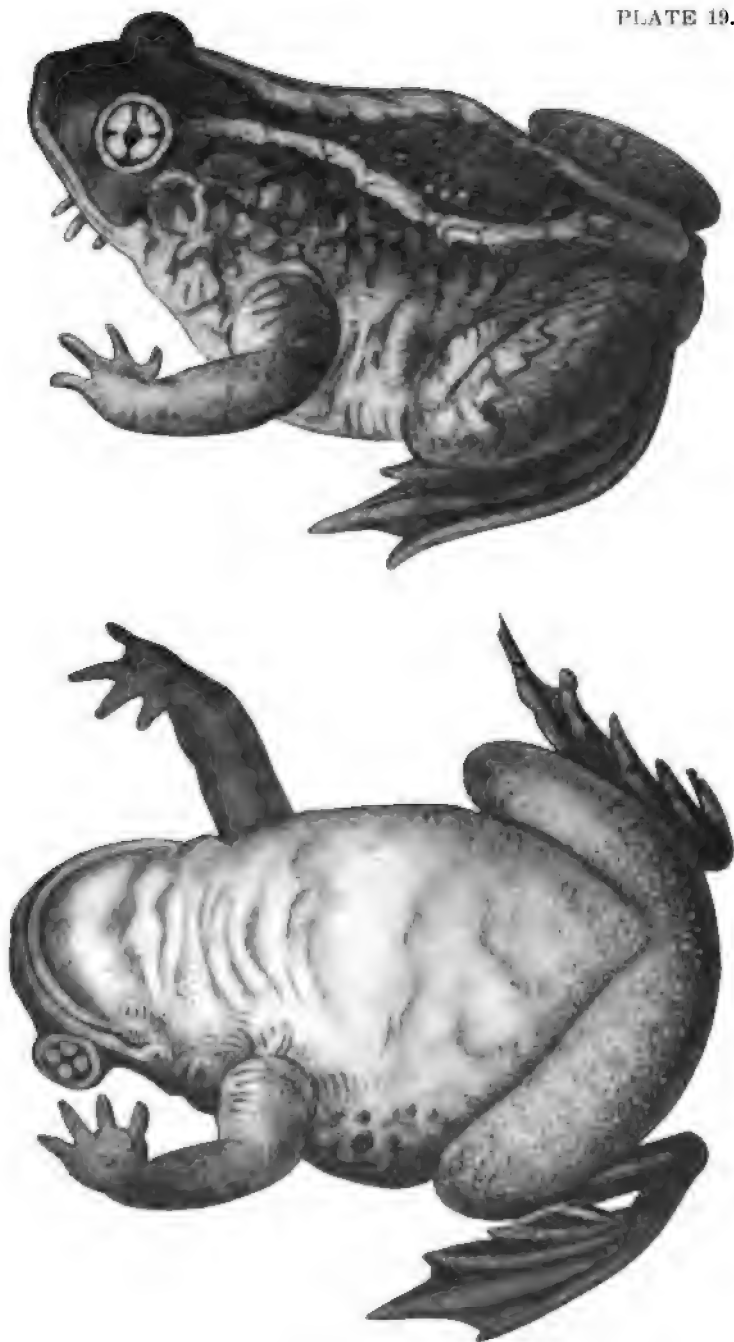


NEWT. *Diemictylus viridescens* (Rafinesque). (Red land form.)



TOAD. *Bufo lentiginos* (Shaw).



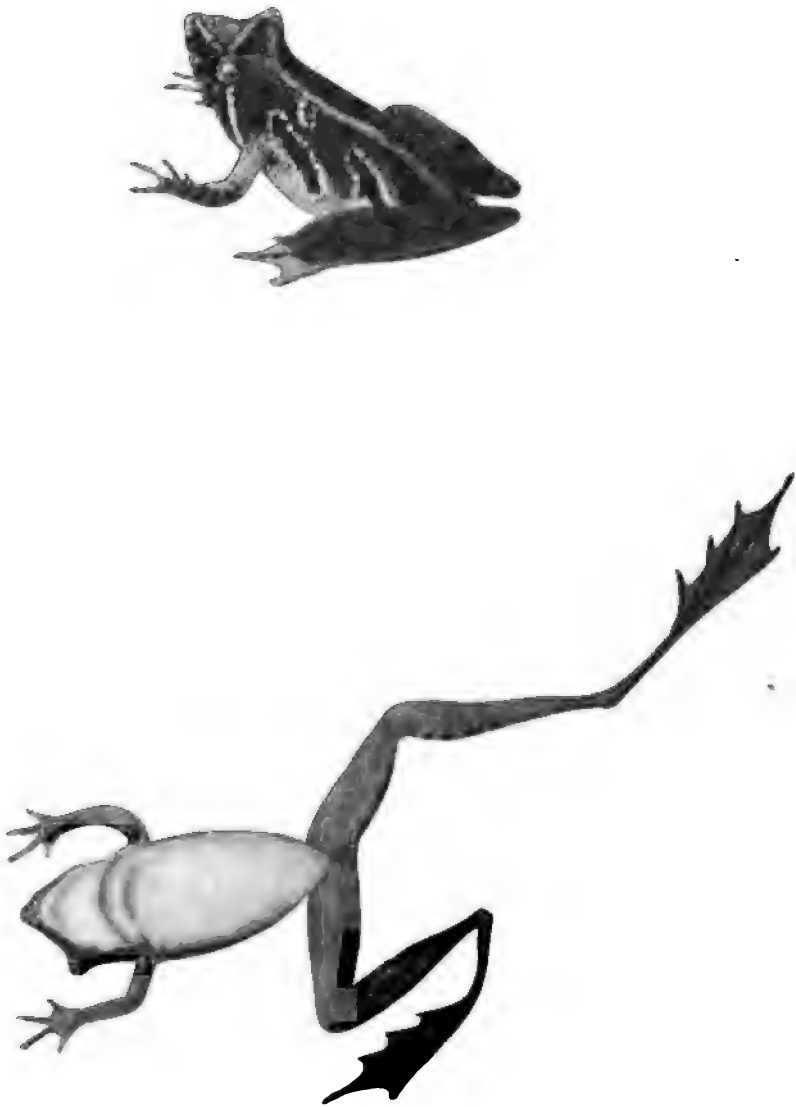


SPADE FOOT TOAD. *Scaphiopus holbrookii* (Harlan).



SWAMP TREE TOAD. *Pseudacris triseriatus* (Wied).





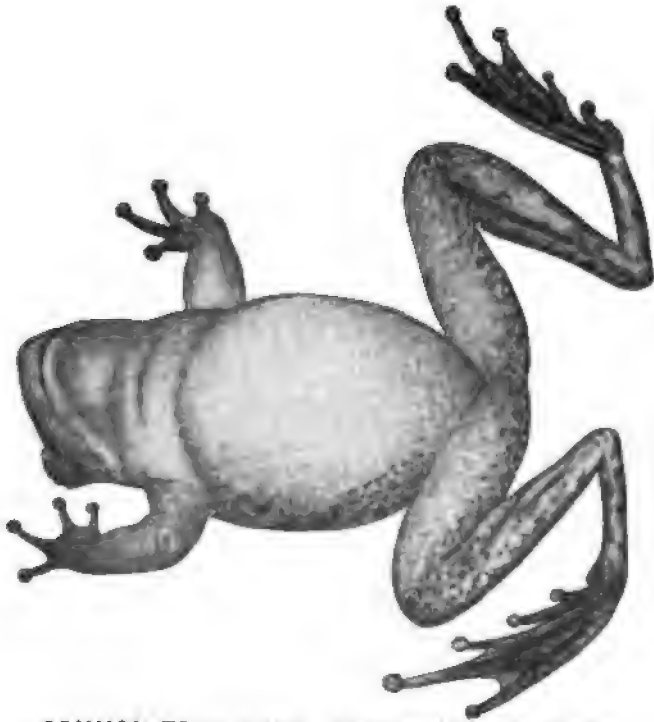
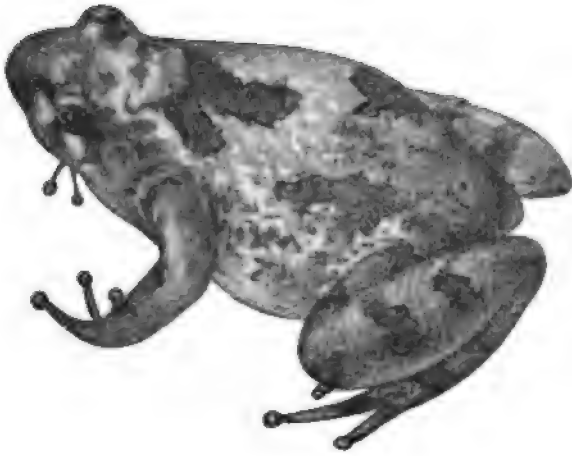
CRICKET TOAD. *Acris gryllus crepitans* (Baird).



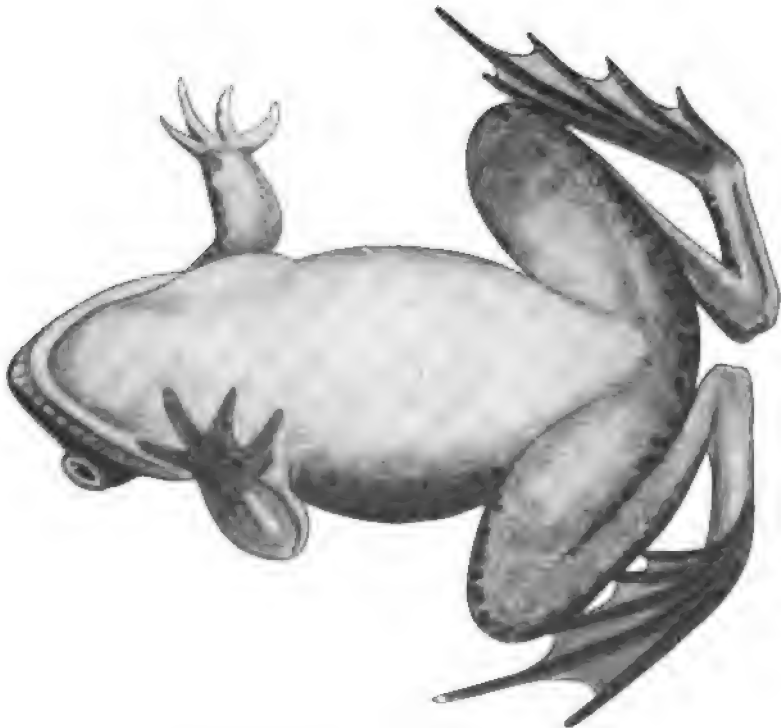
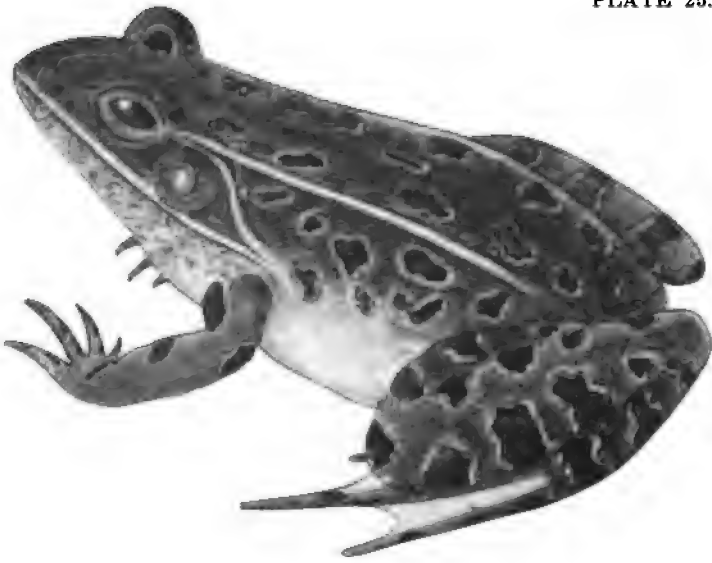
PICKERING'S TREE TOAD. *Hyla pickeringii* (Holbrook).



ANDERSON TREE TOAD. *Hyla andersonii* Baird.



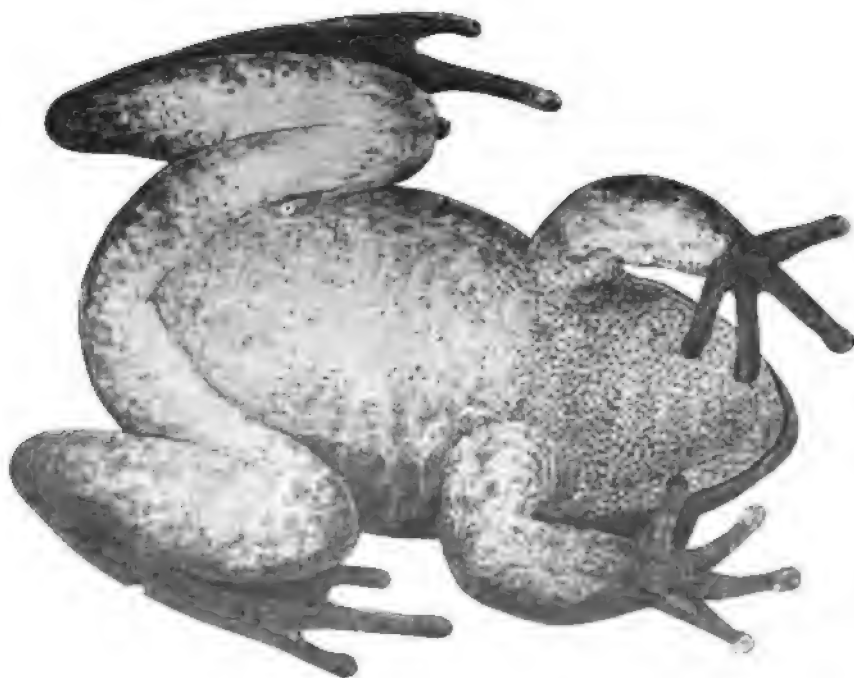
COMMON TREE TOAD. *Hyla versicolor* Le Conte.



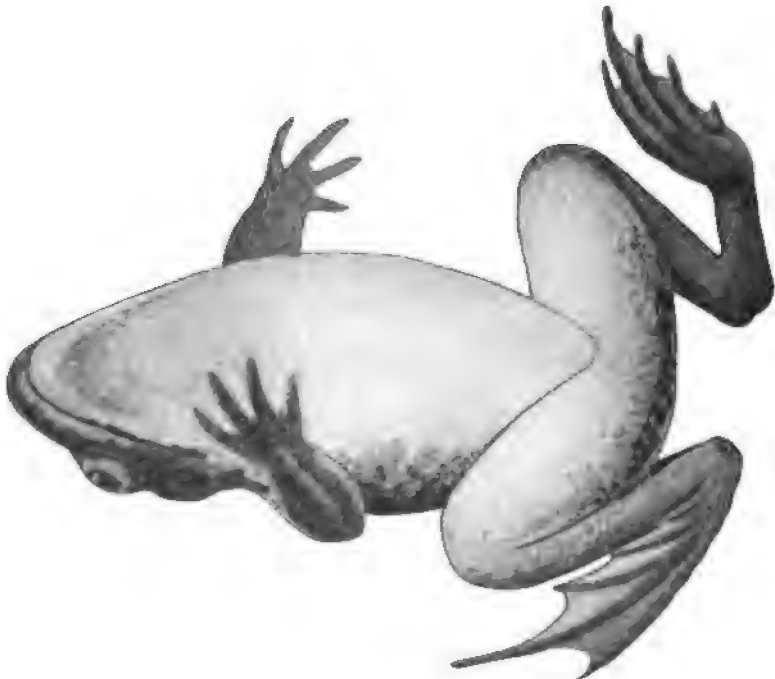
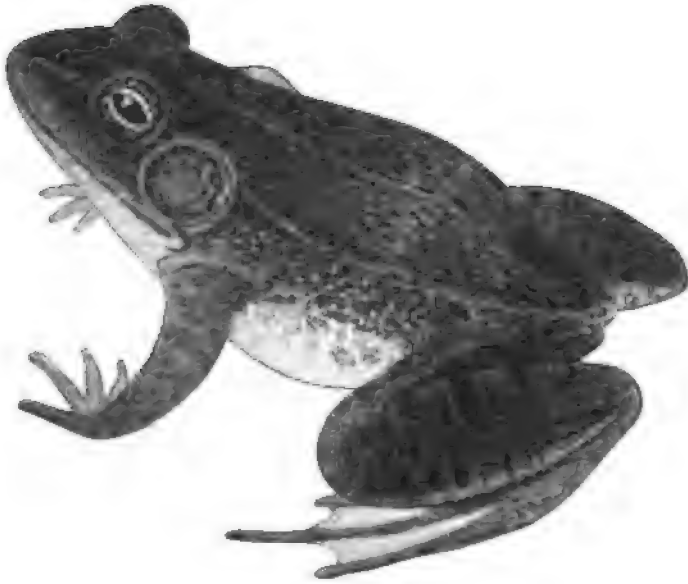
LEOPARD FROG. *Rana pipiens* Schreber.



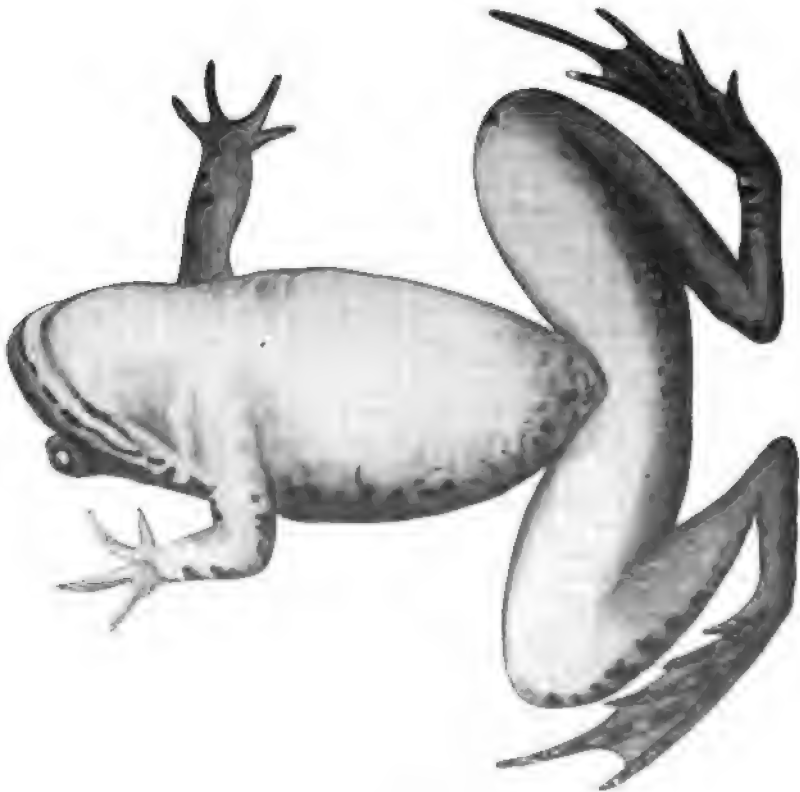
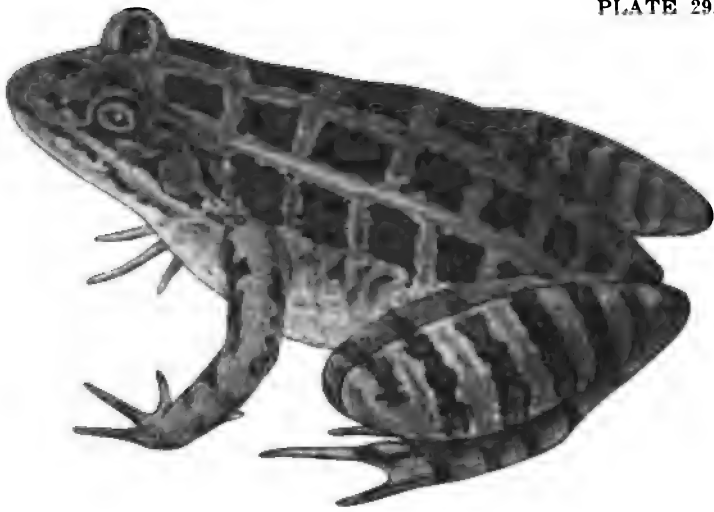
SPHAGNUM FROG. *Rana virgatipes* Cope.



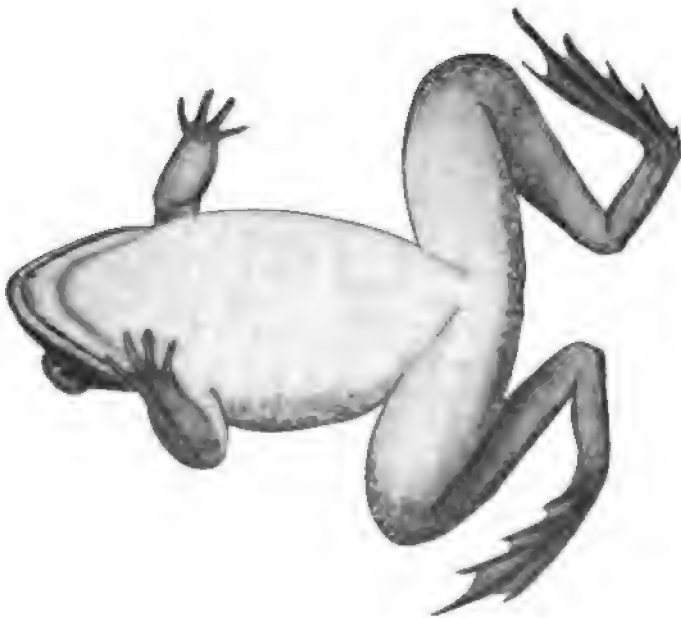
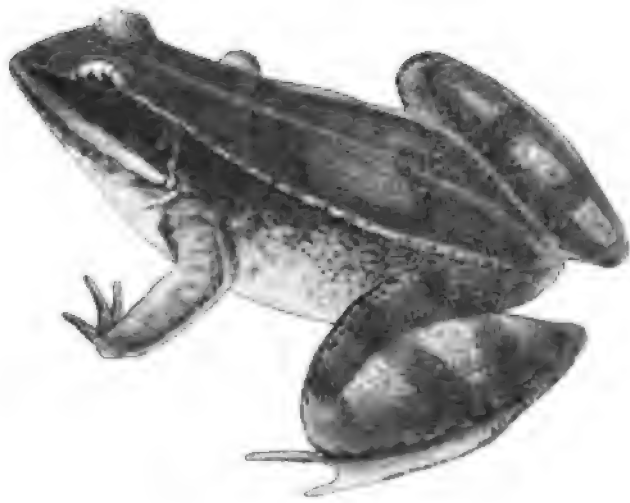
BULL FROG. *Rana catesbeiana* Shaw.



GREEN FROG. *Rana clamata* Daudin.



PICKEREL FROG. *Rana palustris* Le Conte.



WOOD FROG. *Rana sylvatica* Le Copte.



WORM SNAKE. *Carphophiops amœnus* (Say).





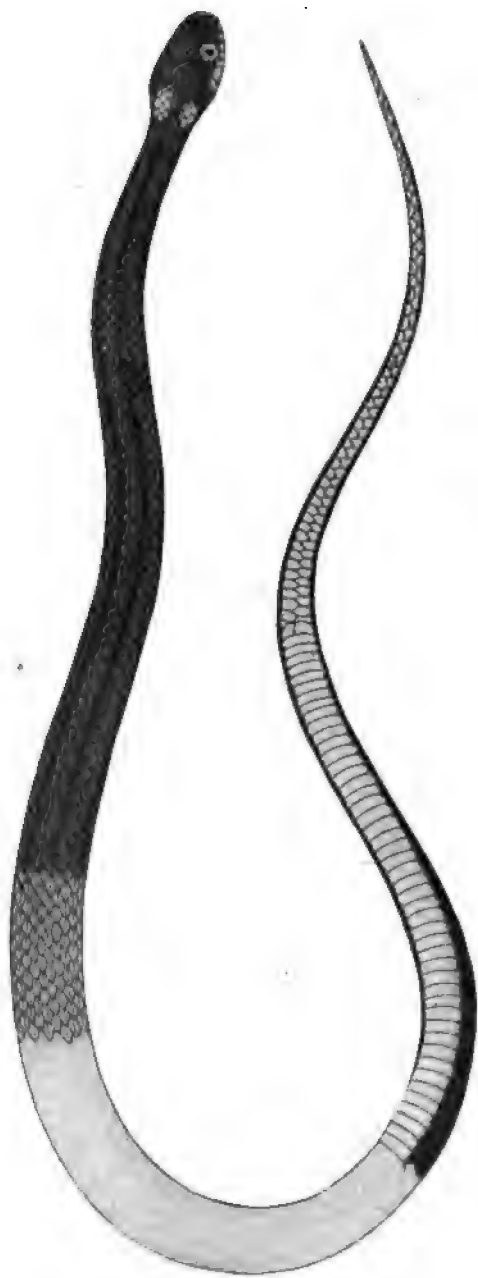
LEATHER SNAKE. *Regina leberis* (Linnaeus).



WATER SNAKE. *Natrix sipedon* (Linnæus).



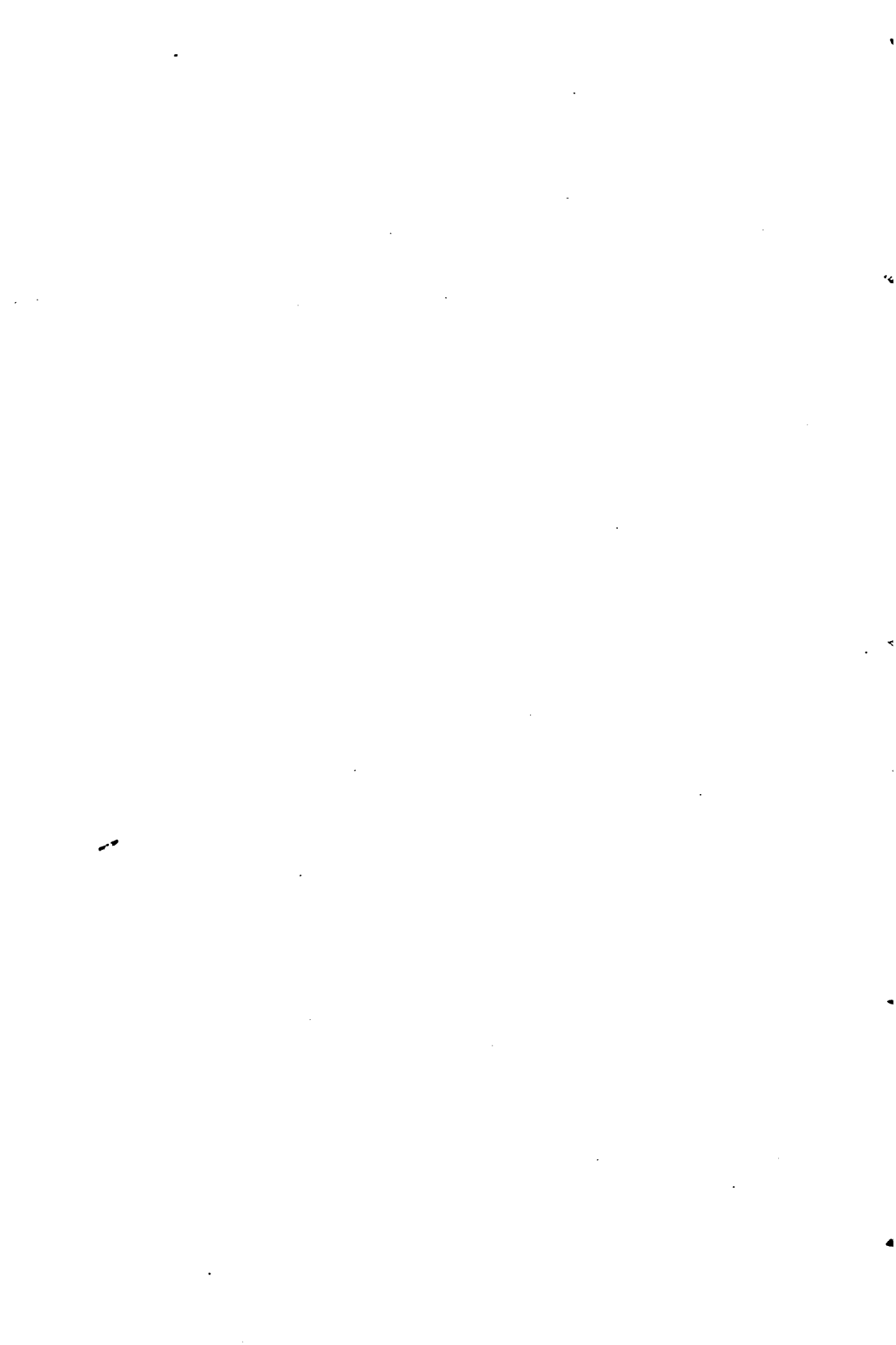
PILOT SNAKE. *Elaphe obsoletus* (Say).

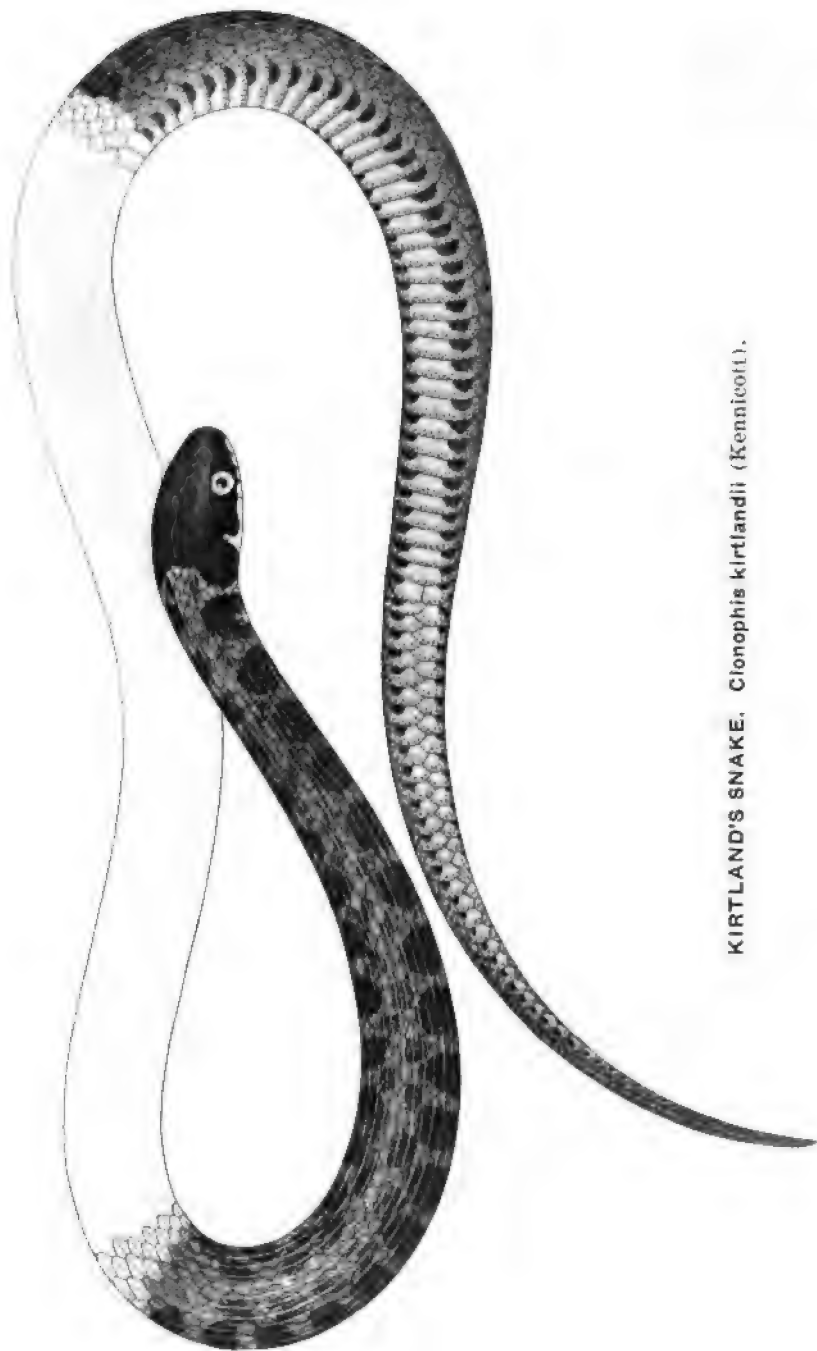


RED BELLIED SNAKE. *Storeria occipito-maculata* (Storer).

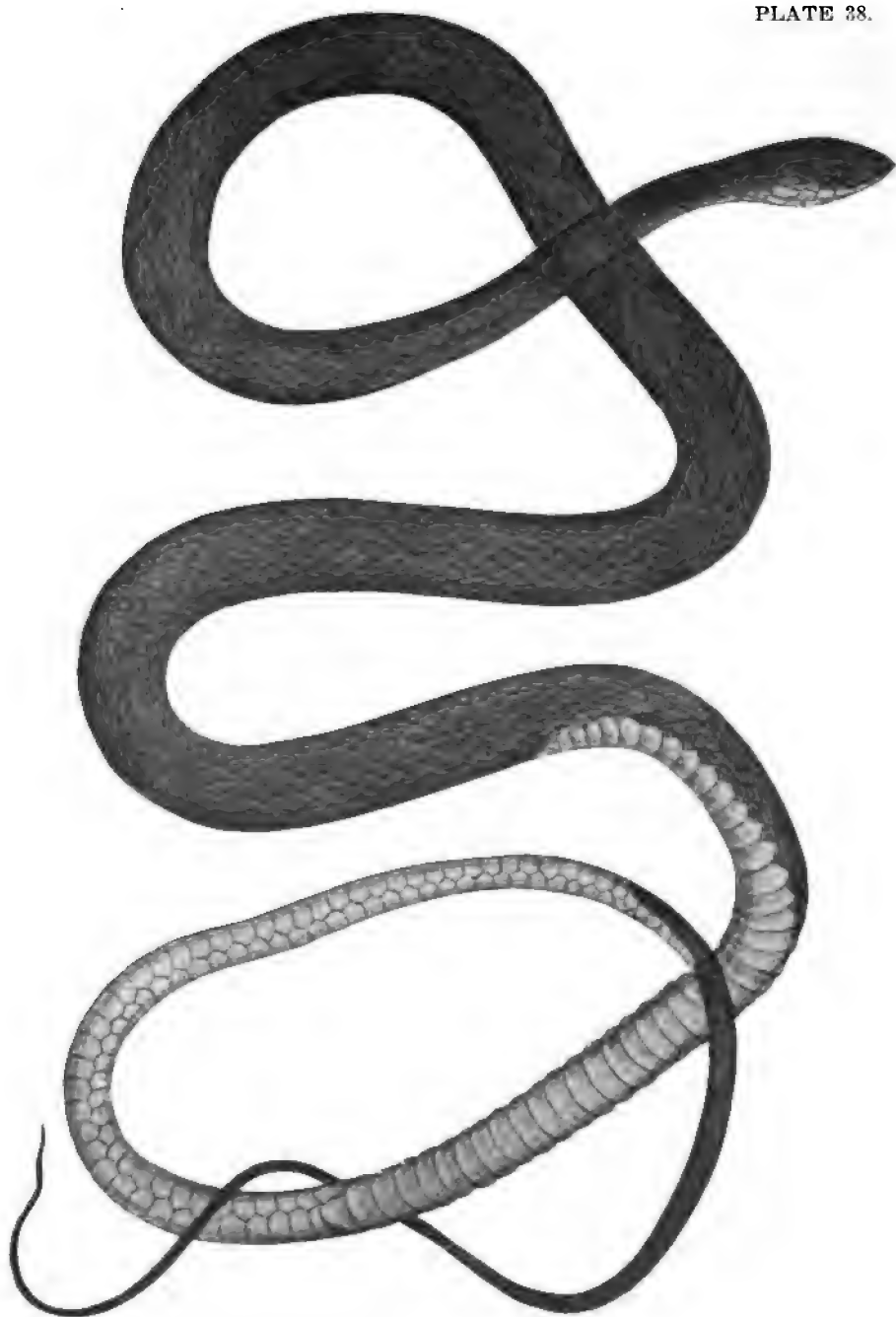


DE KAY'S BROWN SNAKE. *Storeria dekayi* (Holbrook).





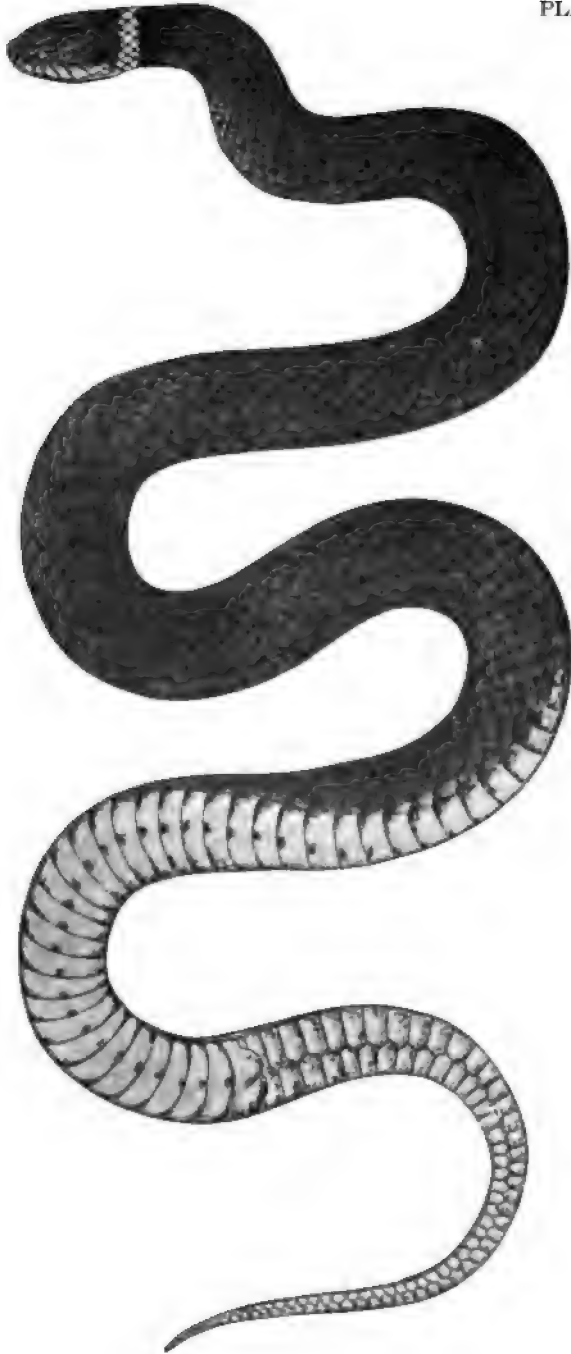
KIRTLAND'S SNAKE. *Clonophis kirtlandii* (Kennicott).



SUMMER SNAKE. *Opheodrys aestivus* (Linnæus).



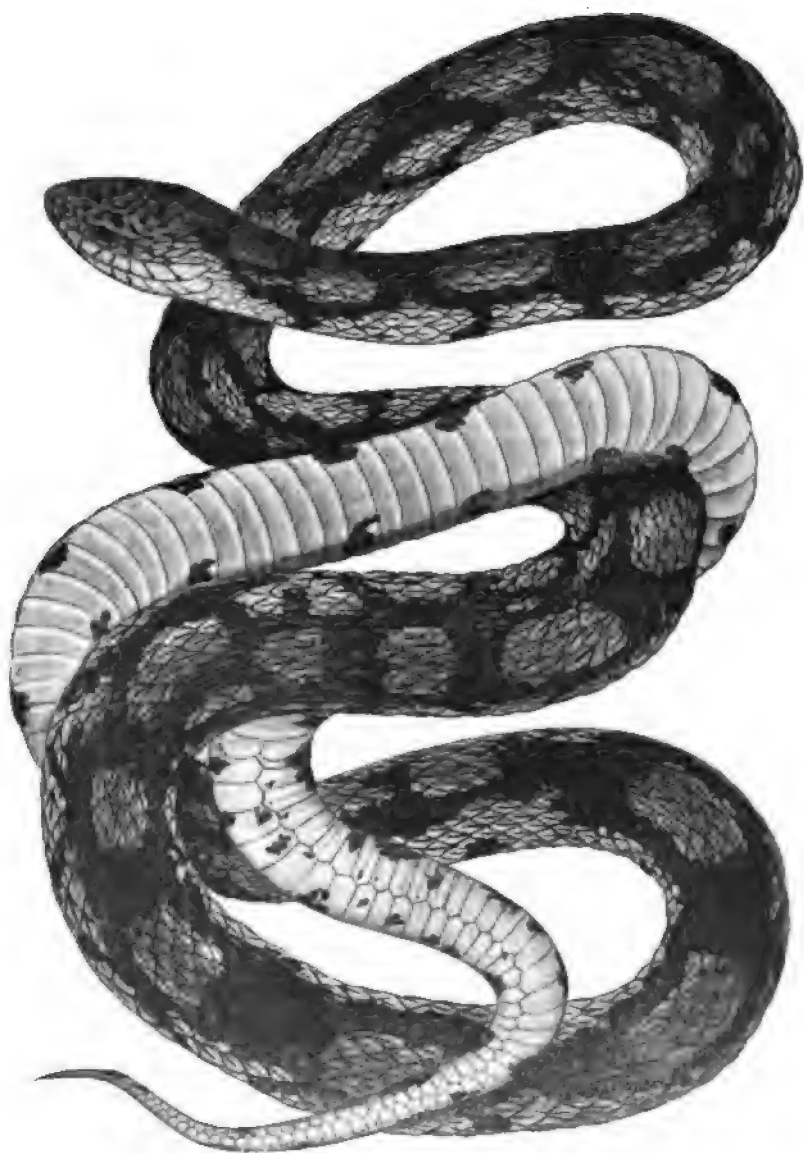
GREEN SNAKE. *Liopeltis vernalis* (Harlan).



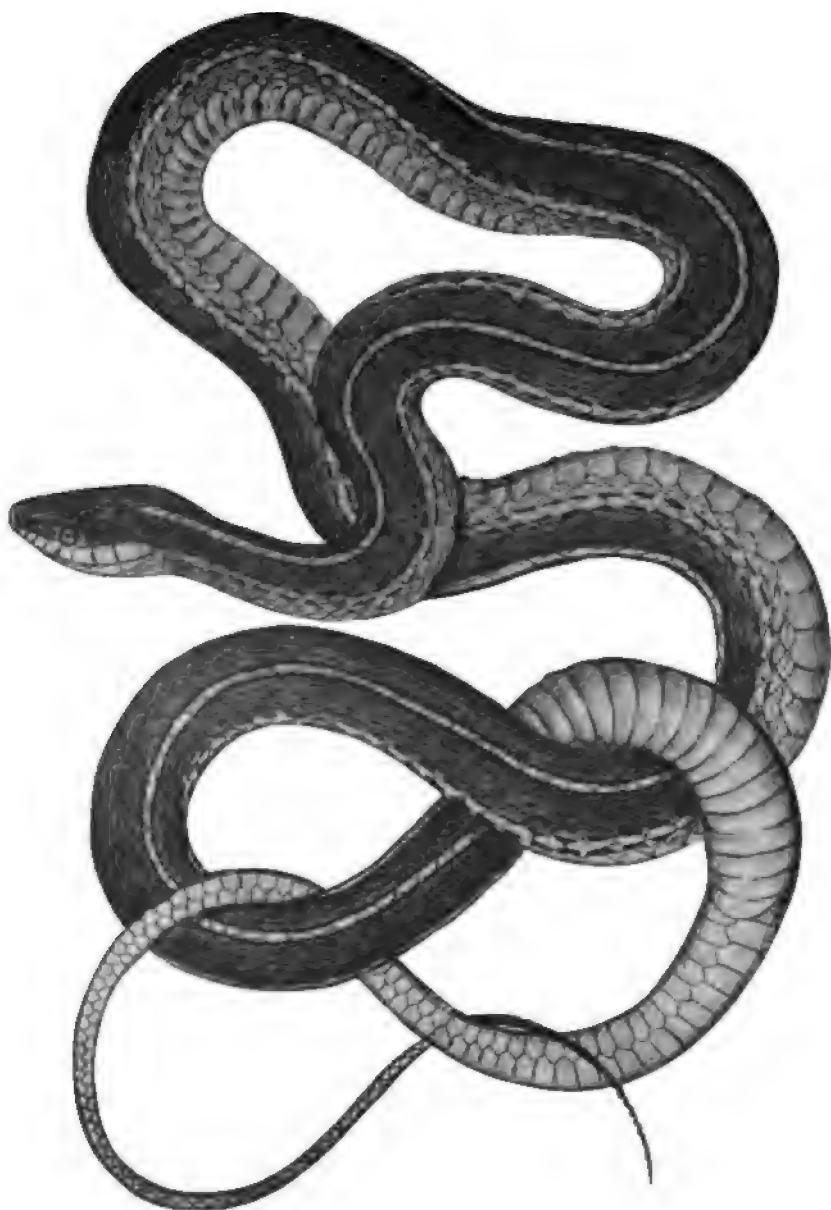
RING NECKED SNAKE. *Diadophis punctatus* (Linnæus).



BLACK SNAKE. *Bascanion constrictor* (Linnæus).



PINE SNAKE. *Pituophis melanoleucus* (Daudin).

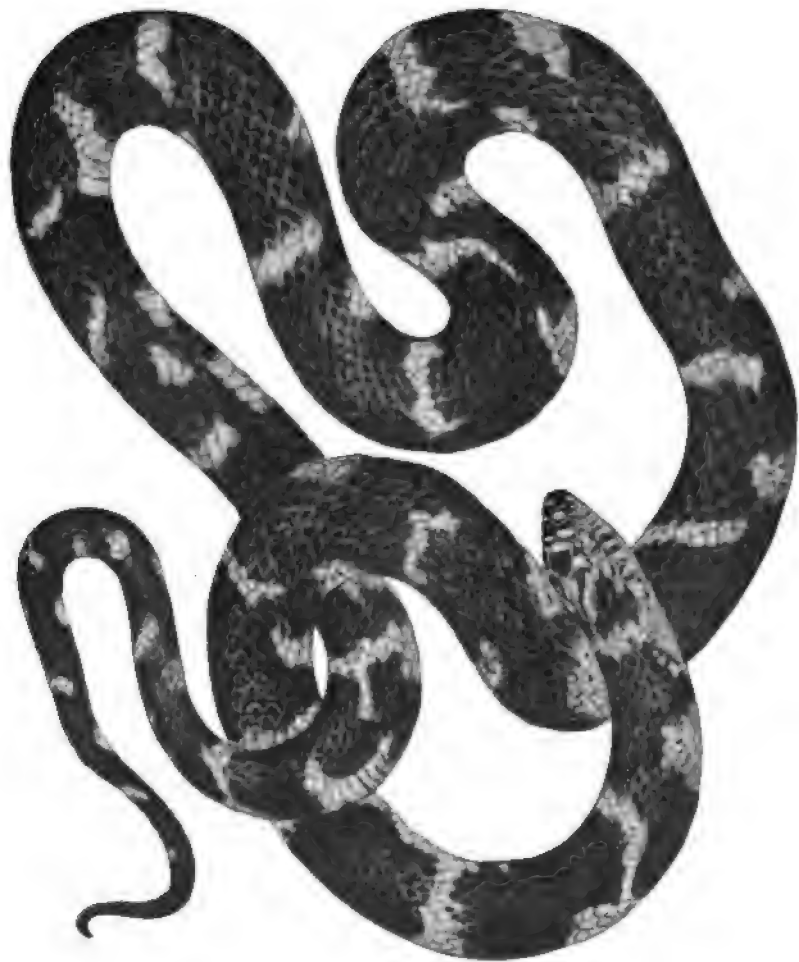


RIBBAND SNAKE. *Thamnophis sauritus* (Linnæus).



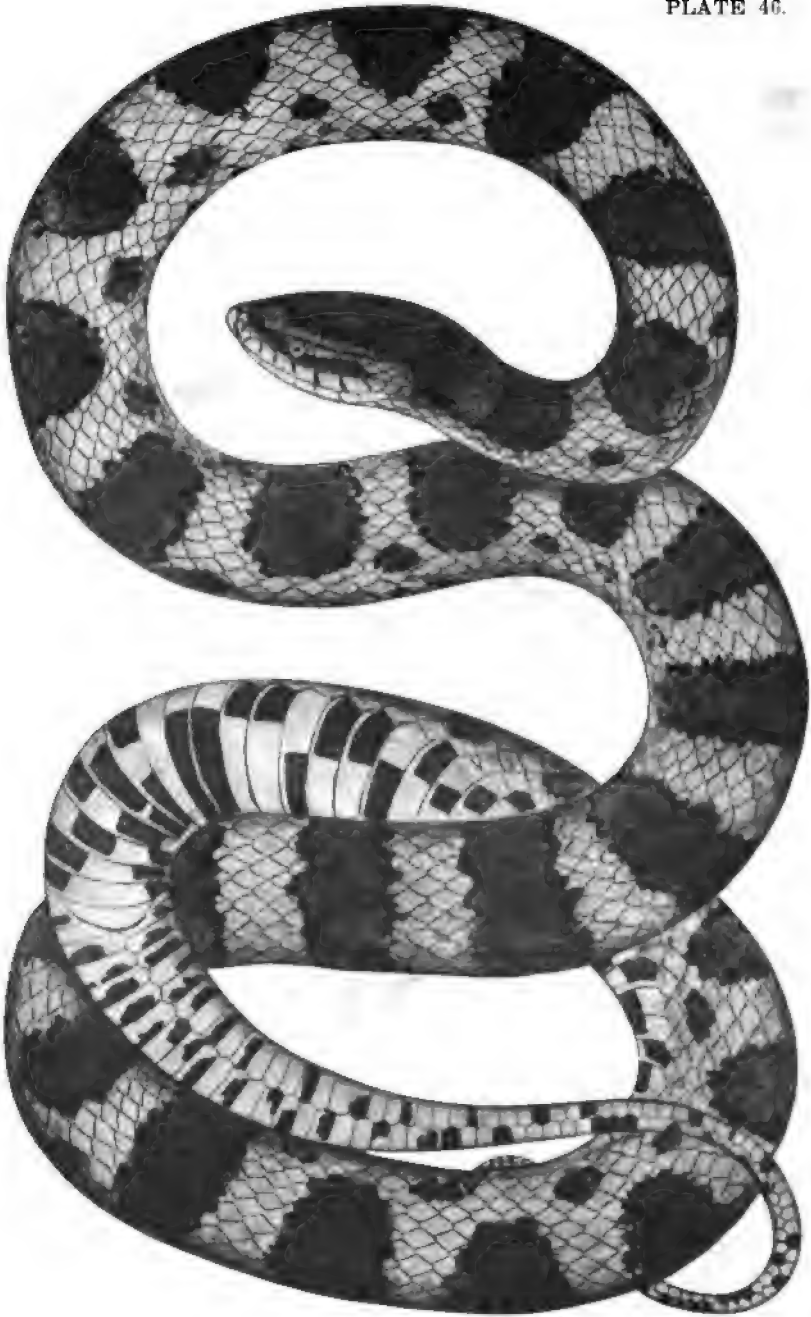
GARTER SNAKE. *Thamnophis sirtalis* (Linnæus).



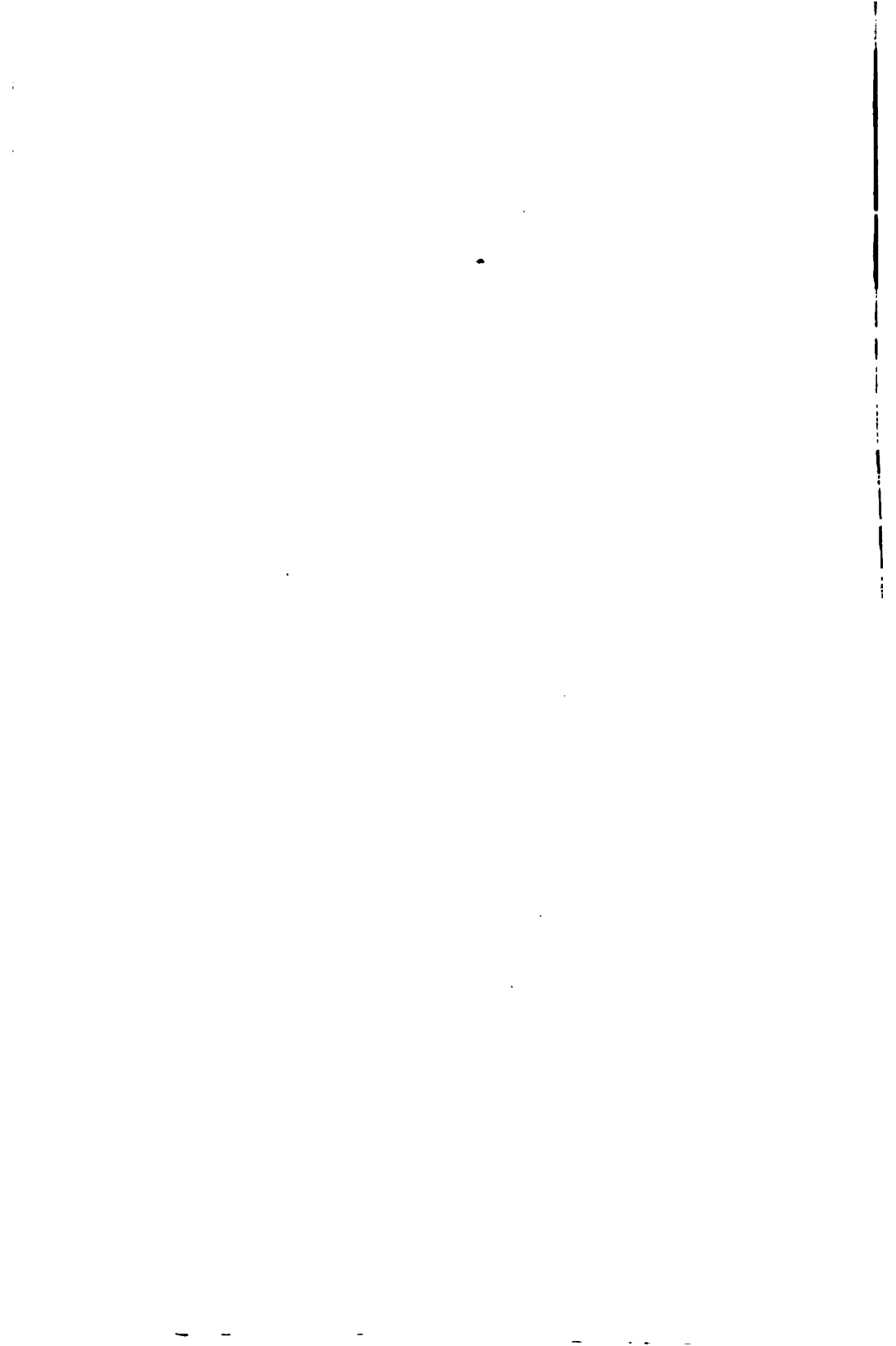


CHAIN SNAKE. *Lampropeltis getulus* (Linnaeus).





HOUSE SNAKE. *Lampropeltis doliiatus* (Linnæus).





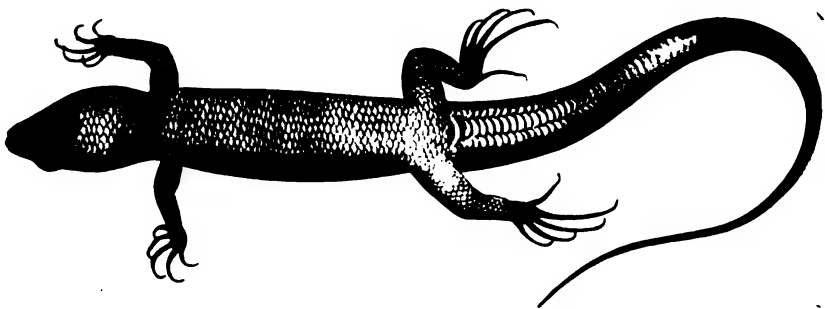
HOG NOSED SNAKE. *Heterodon platirhinos* (Latreille).



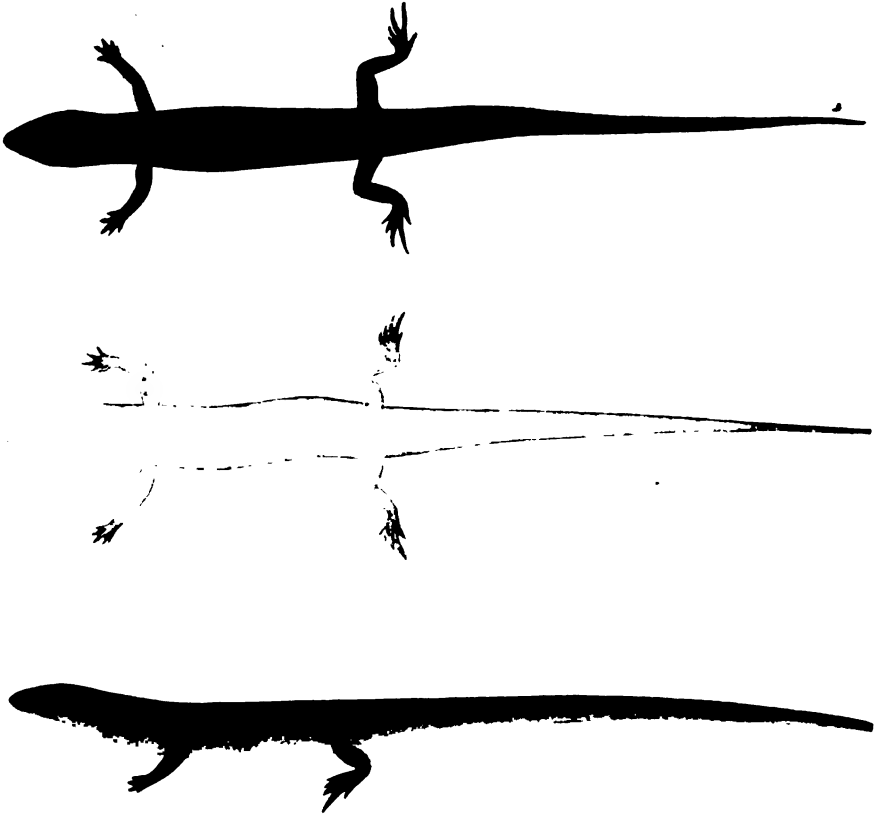
COPPER HEAD SNAKE. *Agkistrodon contortrix* (Linnæus).



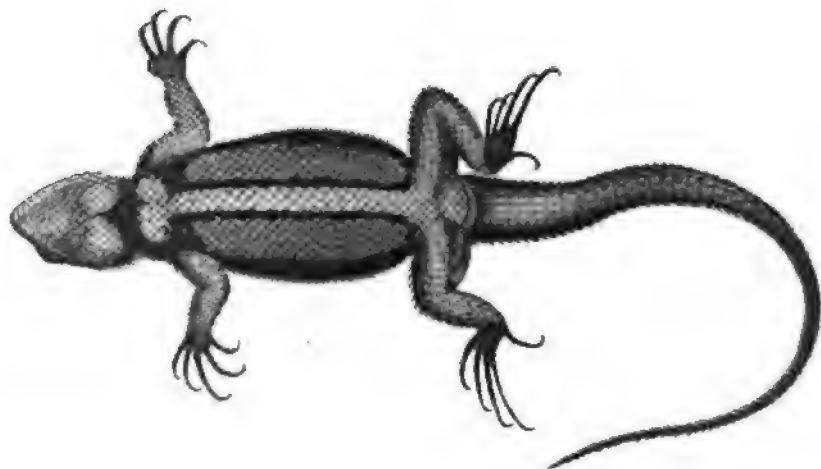
RATTLE SNAKE. *Crotalus horridus* Linnæus.



BLUE TAILED LIZARD. *Eumeces fasciatus* (Linnæus).

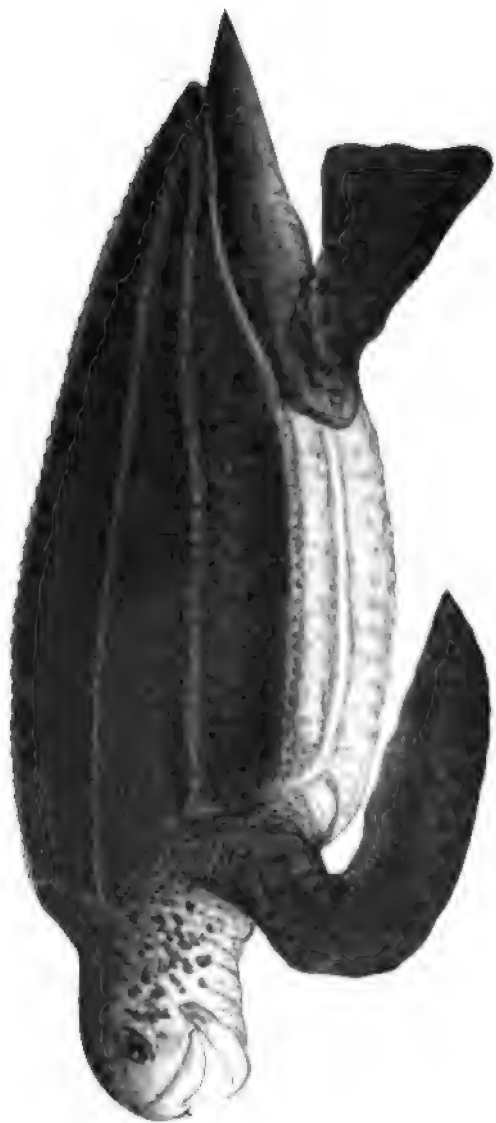


BLACK BANDED LIZARD. *Leiopeltis laterale* (Say).

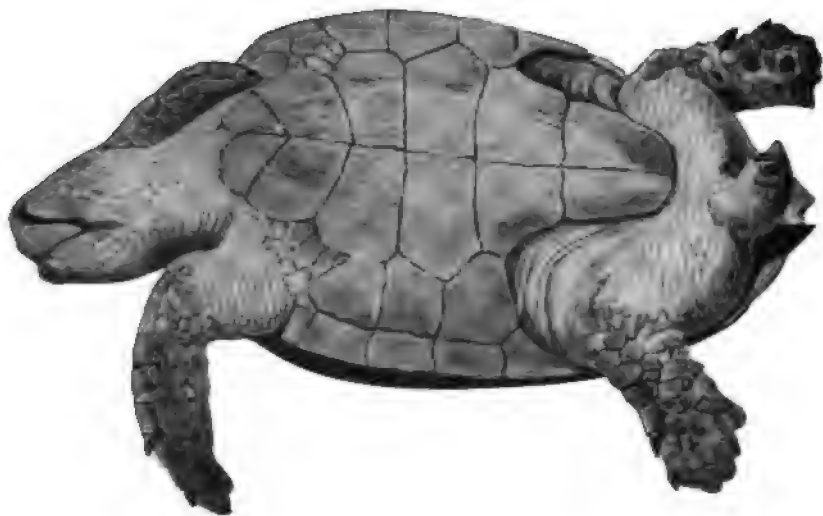
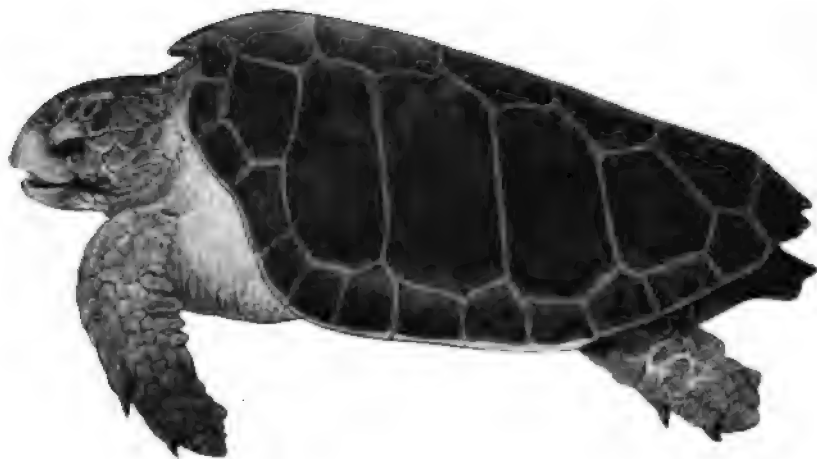


PINE TREE LIZARD. *Sceloporus undulatus* (Latreille).





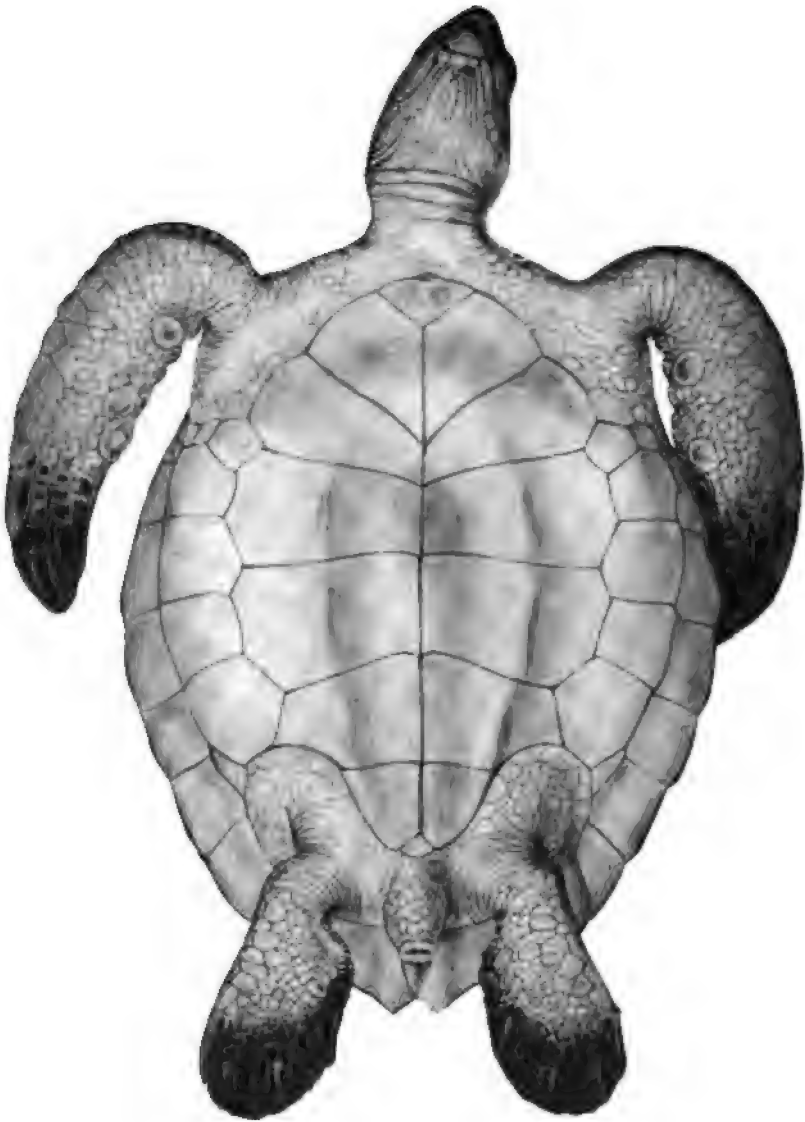
LEATHER TURTLE. *Dermochelys coriacea* (Vandell).



LOGGER HEAD TURTLE. *Caretta caretta* (Linnæus).

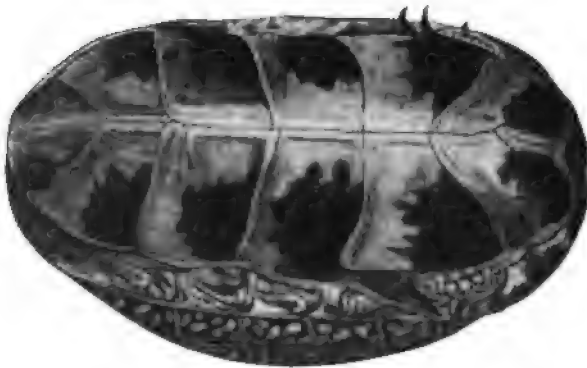
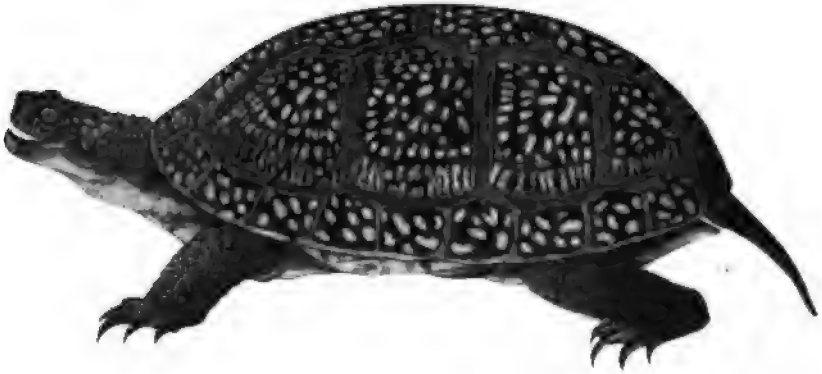


GREEN TURTLE. *Chelonia mydas* (Linnæus). (Upper view.)



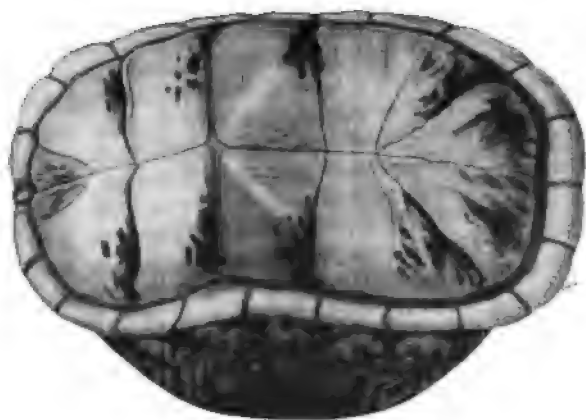
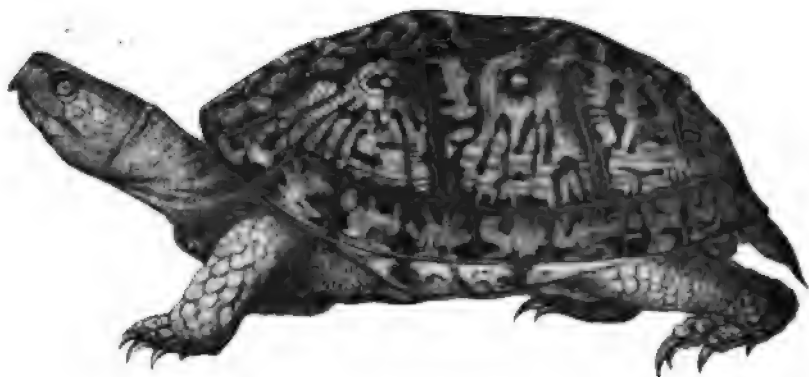
GREEN TURTLE. *Chelonia mydas* (Linnæus). (Lower view.)





BLANDING'S TURTLE. *Emydoidea blandingi* (Holbrook).



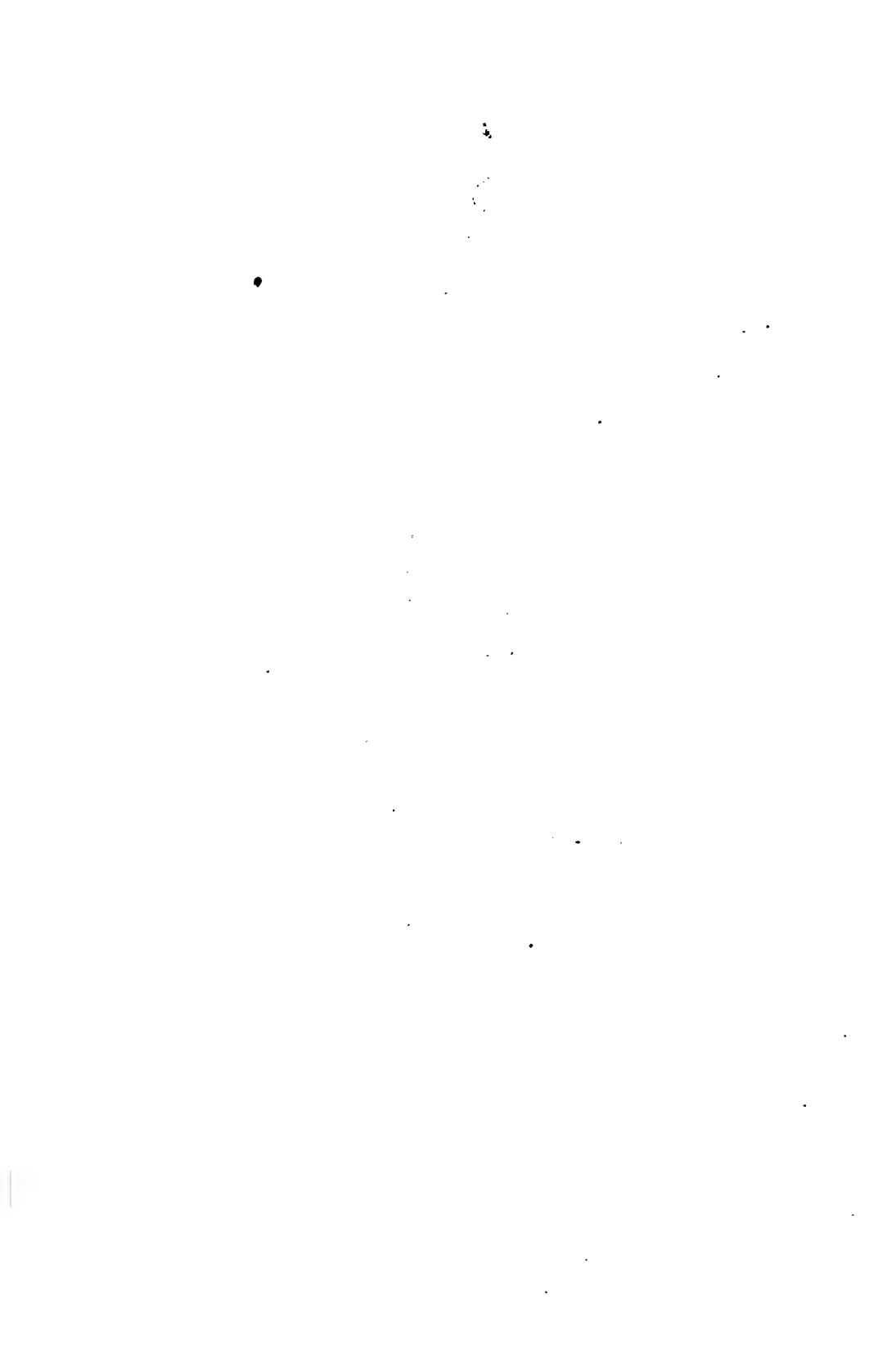


BOX TORTOISE. *Didicla carolina* (Linnæus).





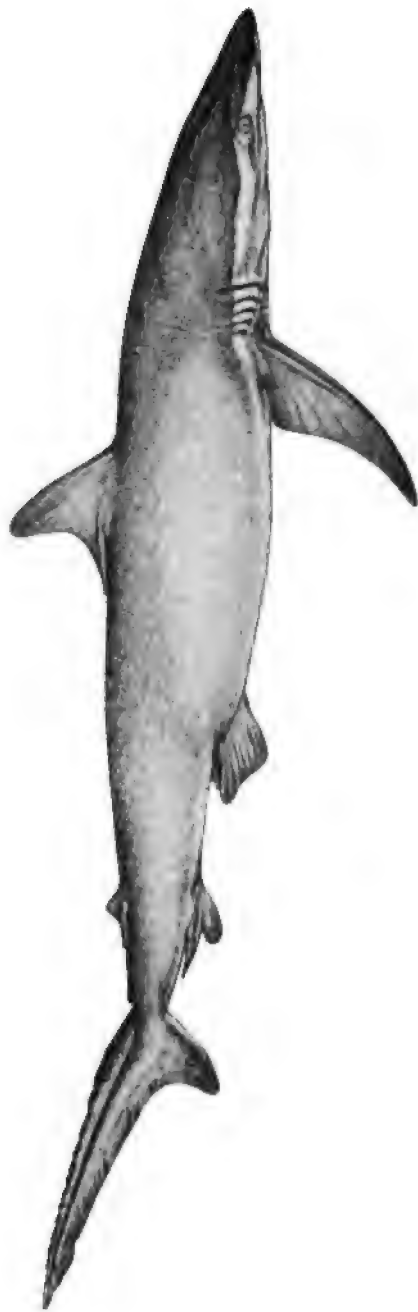
SAND SHARK. *Carcharias littoralis* (Mitchill).



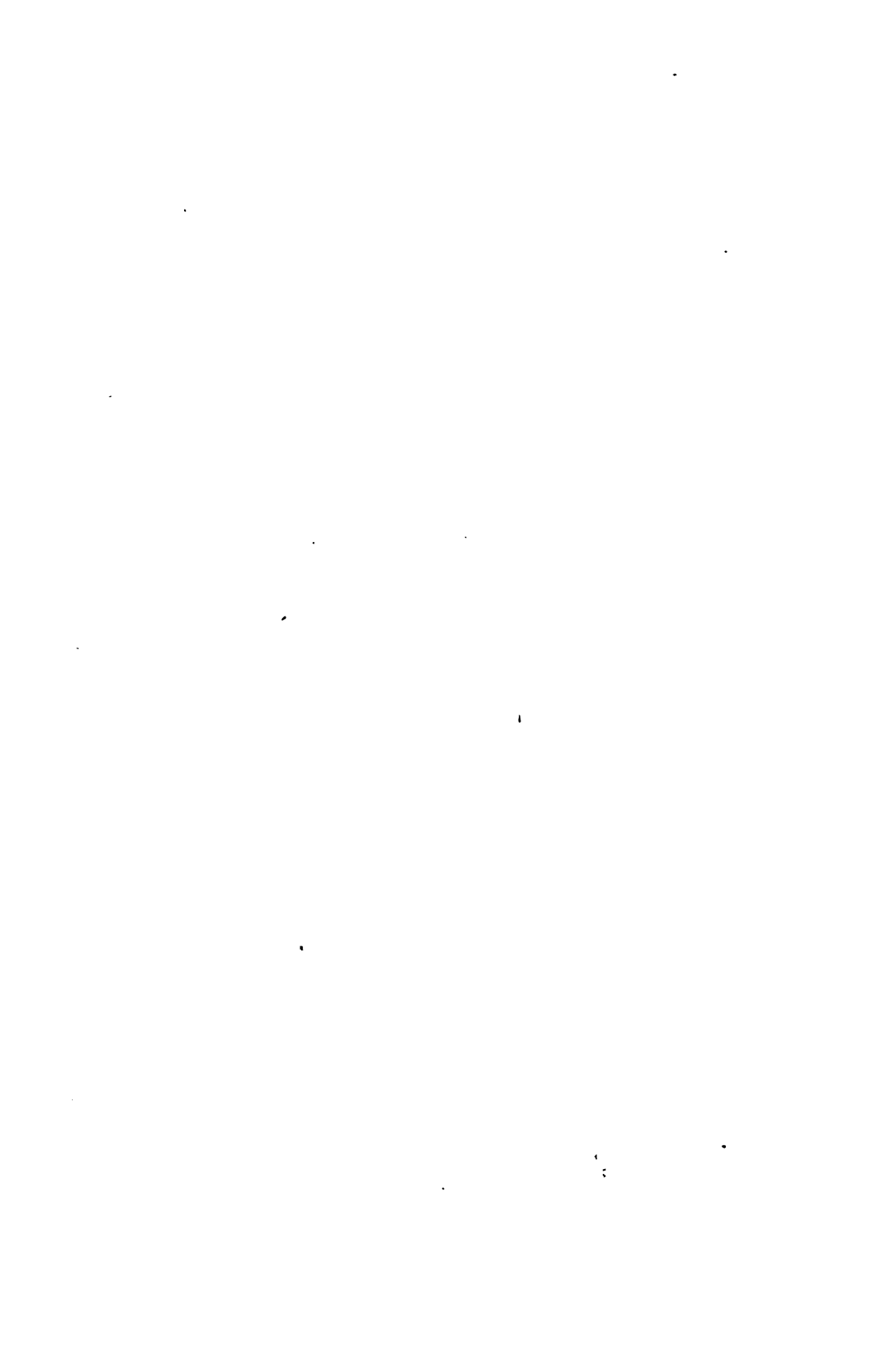


LEOPARD SHARK. *Galeocerdo tigrinus* Müller and Henle.





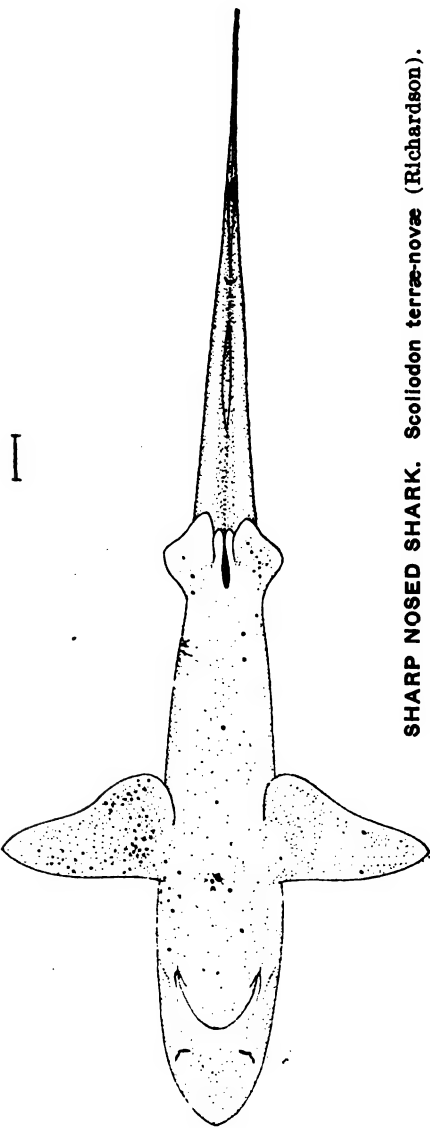
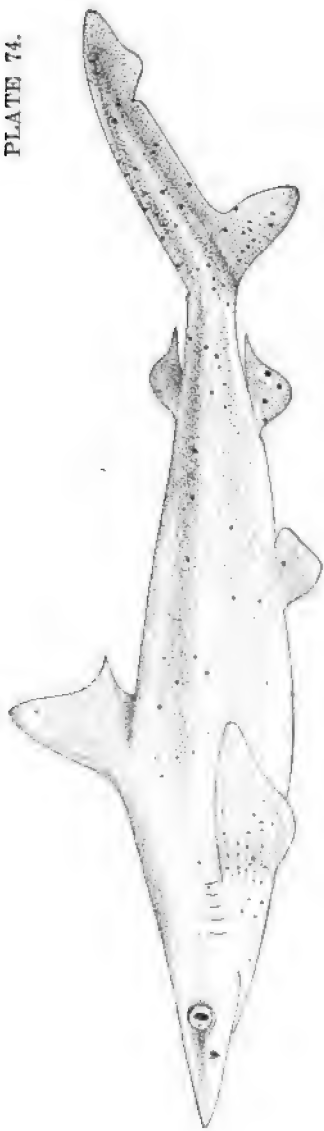
DUSKY SHARK. *Carcharhinus obscurus* (Le Sueur).





SMALL WHITE SHARK. *Carcharhinus milberti* (Müller and Henle).

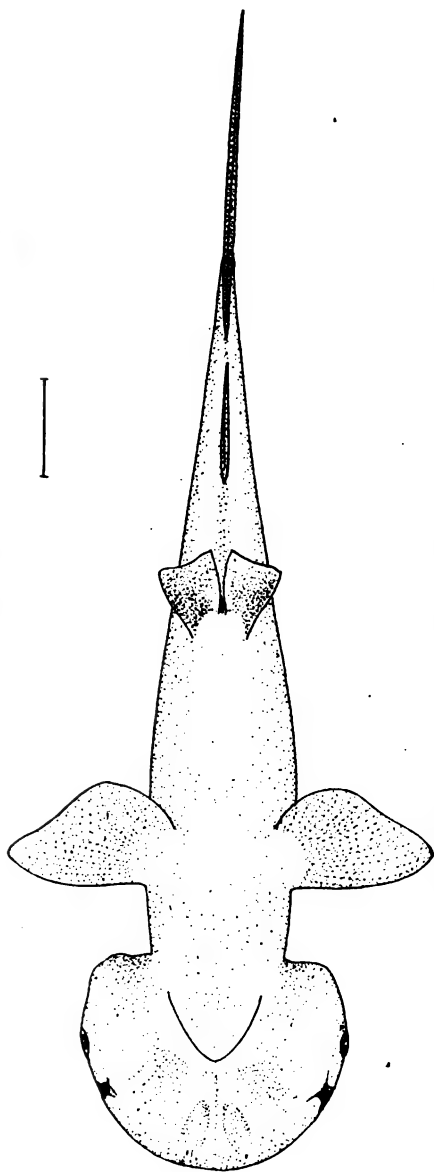
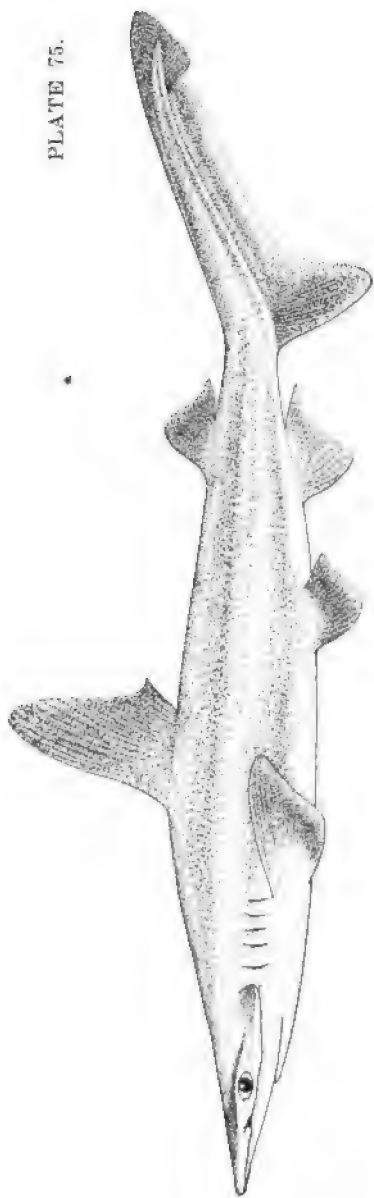
PLATE 74.



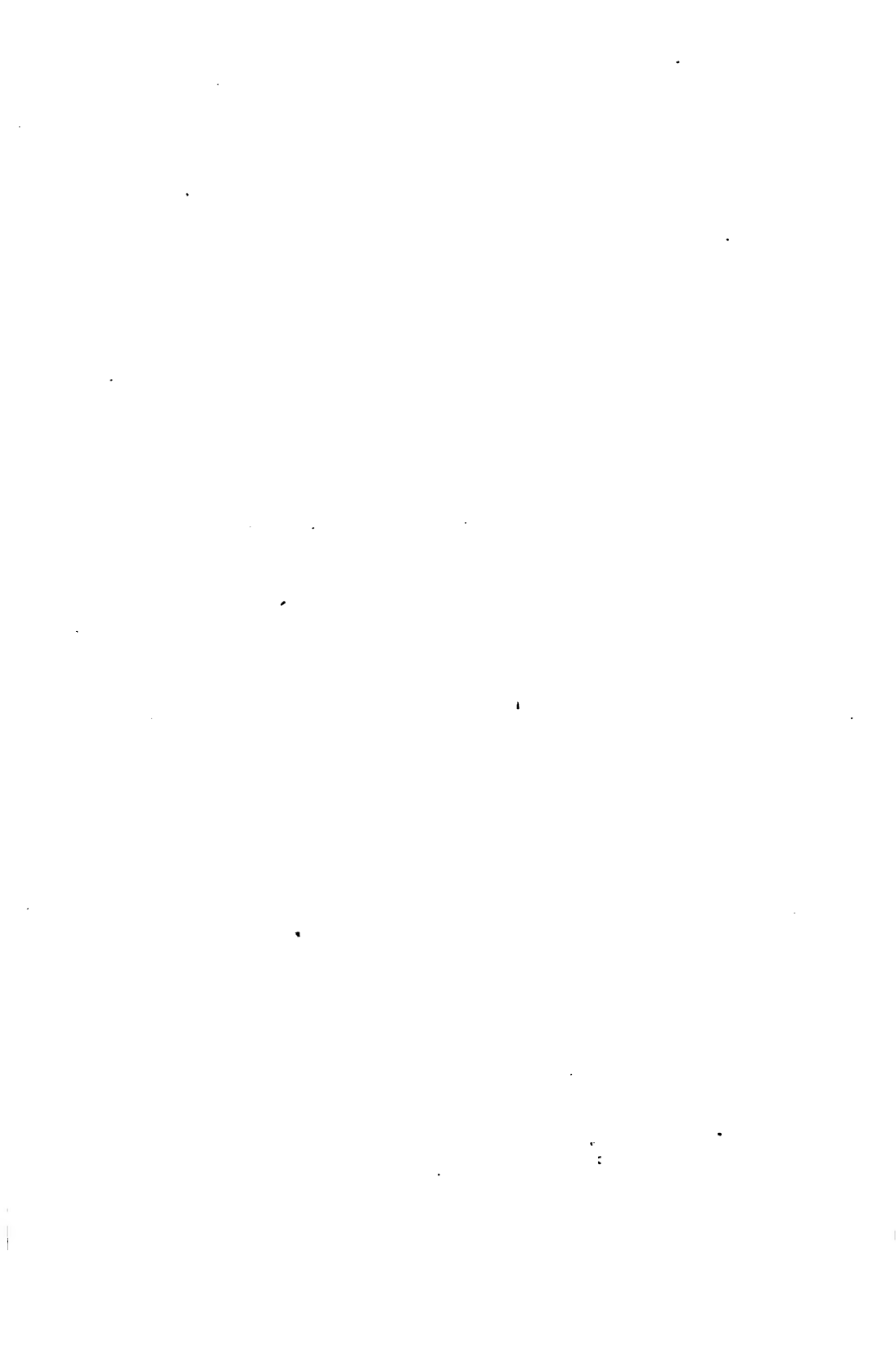
I

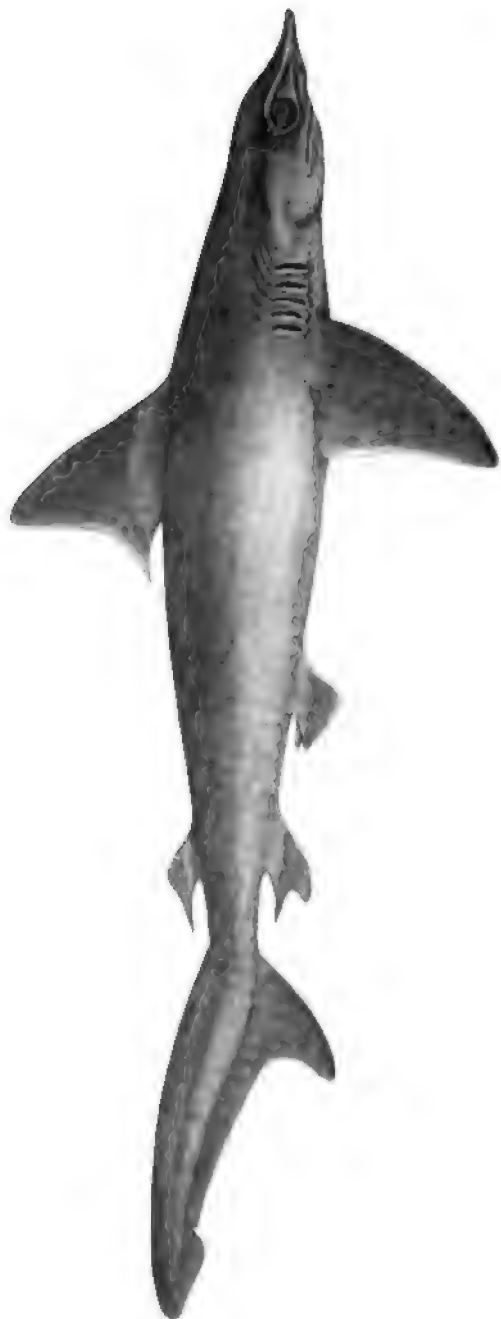
SHARP NOSED SHARK. *Scoliodon terraenovae* (Richardson).

PLATE 75.



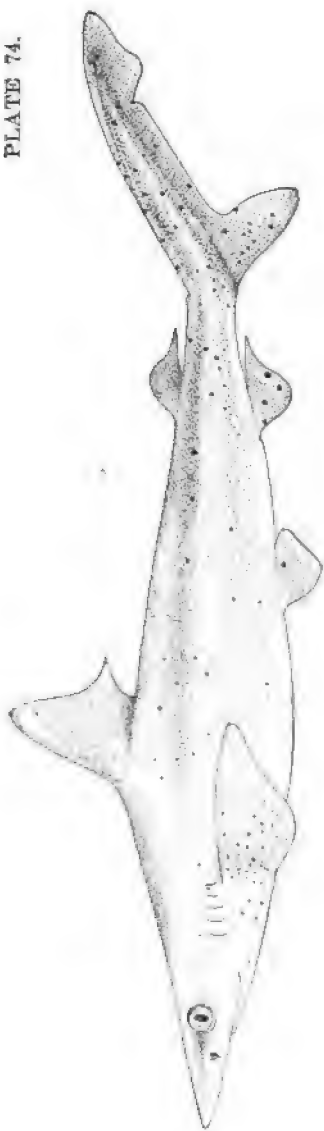
BONNET HEADED SHARK. *Cestracion tiburo* (Linnæus).



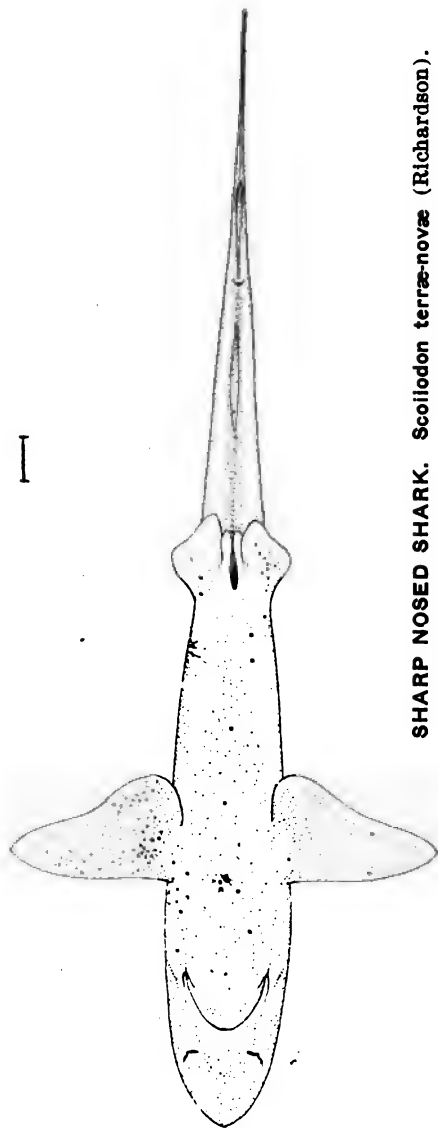


SMALL WHITE SHARK. *Carcharhinus milberti* (Müller and Henle).

PLATE 74.

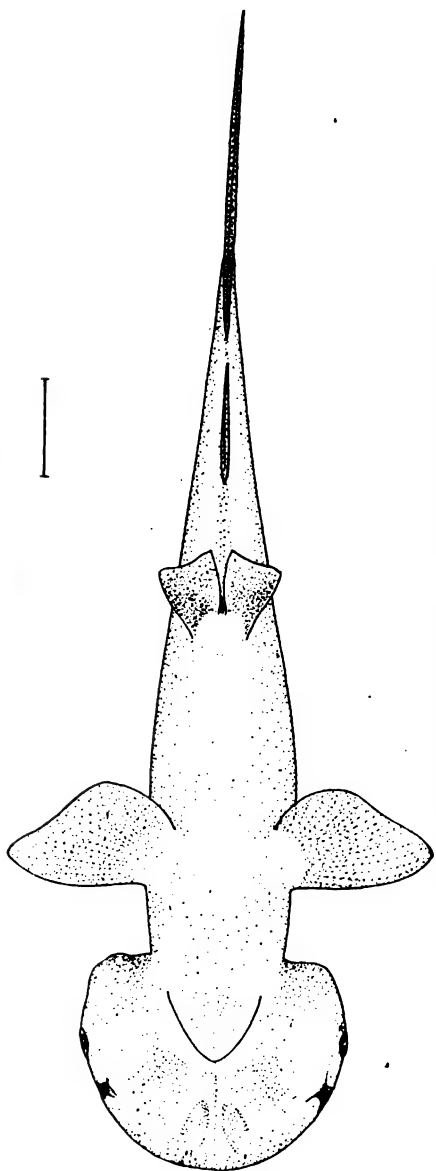
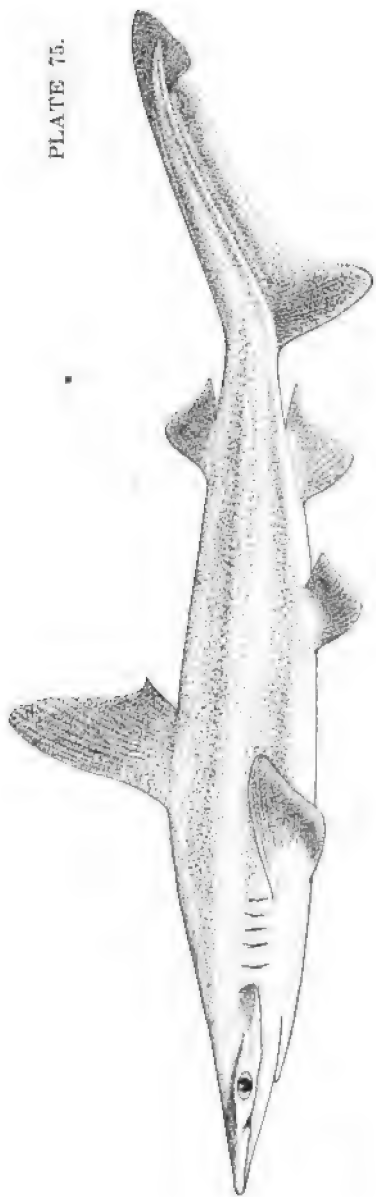


I

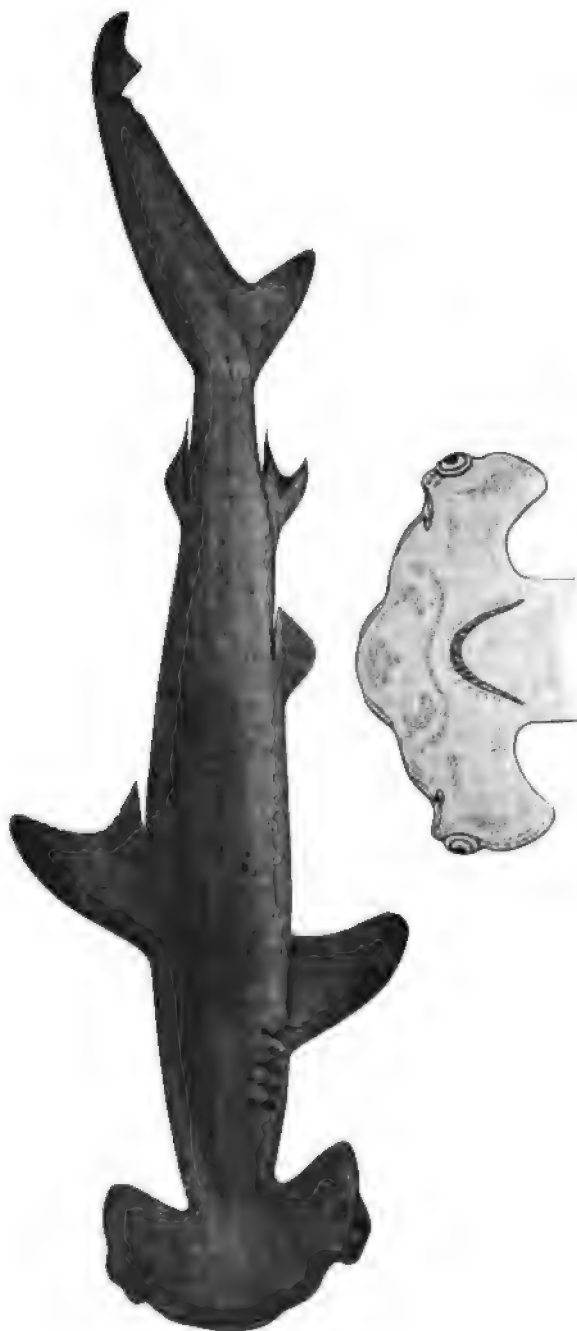


SHARP NOSED SHARK. *Scoliodon terraenovae* (Richardson).

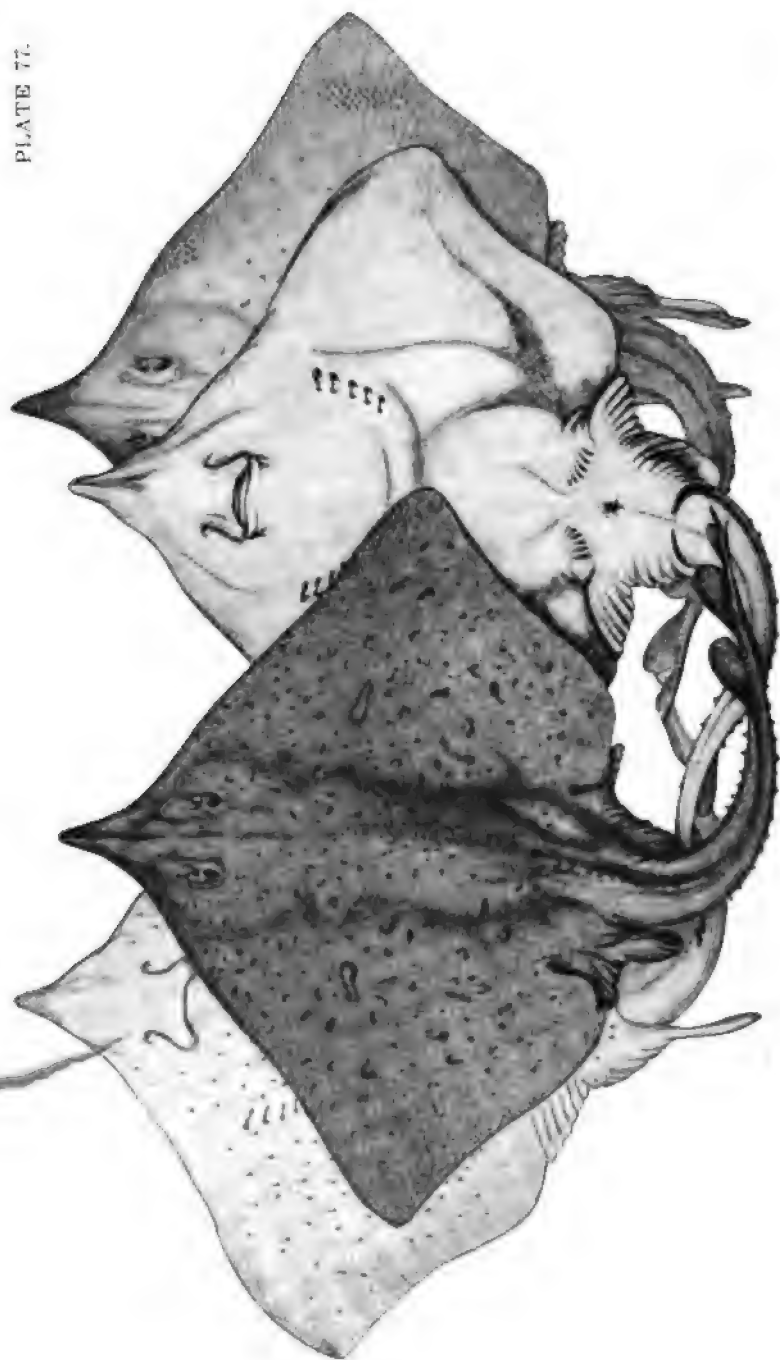
PLATE 75.



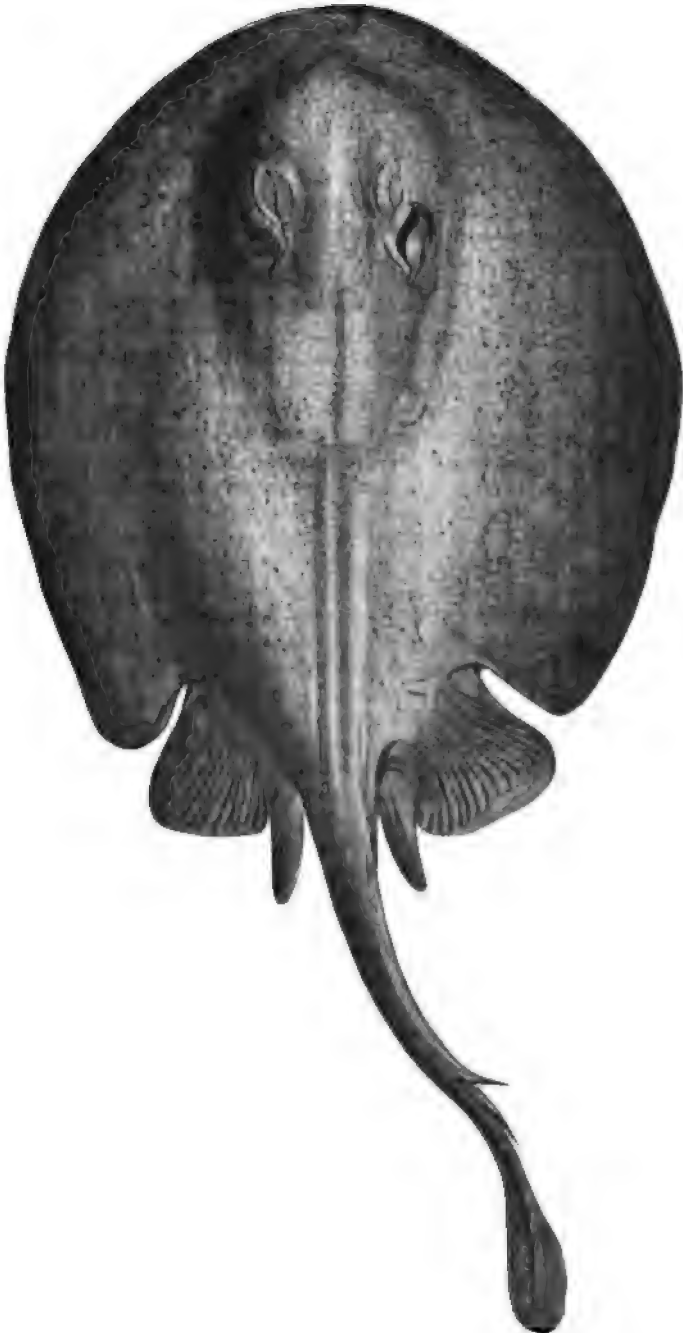
BONNET HEADED SHARK. *Cestracion tiburo* (Linnaeus).



HAMMER HEAD SHARK. *Cestracion zygena* (Linnaeus).



COMMON SPECKLED SKATE. *Raja eglanteria* Lacépède.

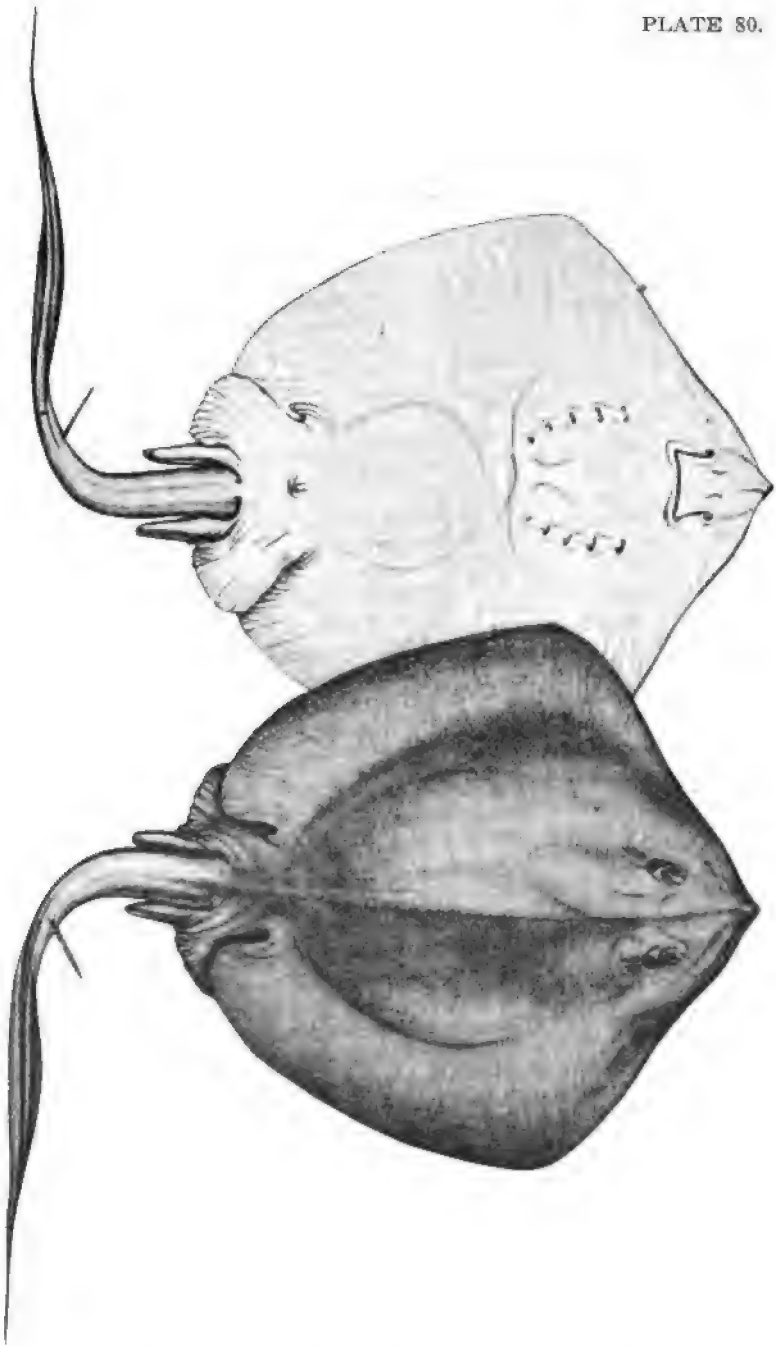


ROUND STING RAY. *Urolophus jamaicensis* (Cuvier).

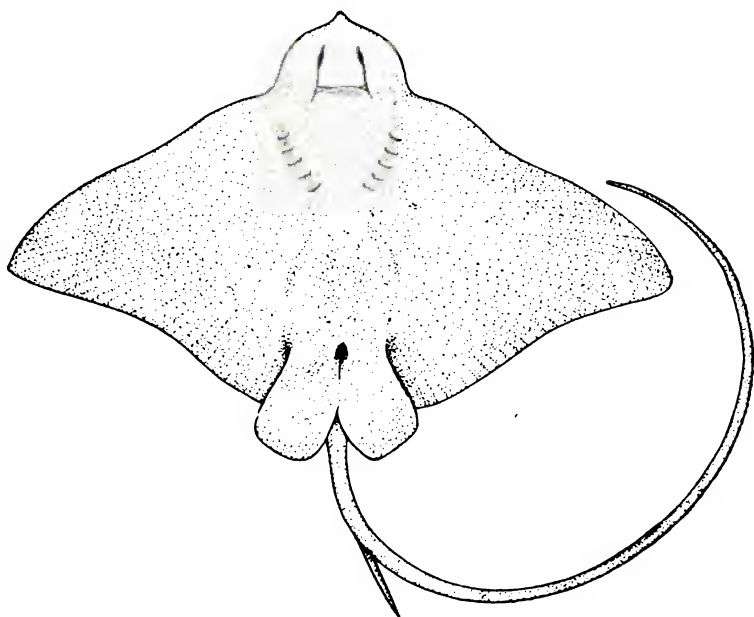
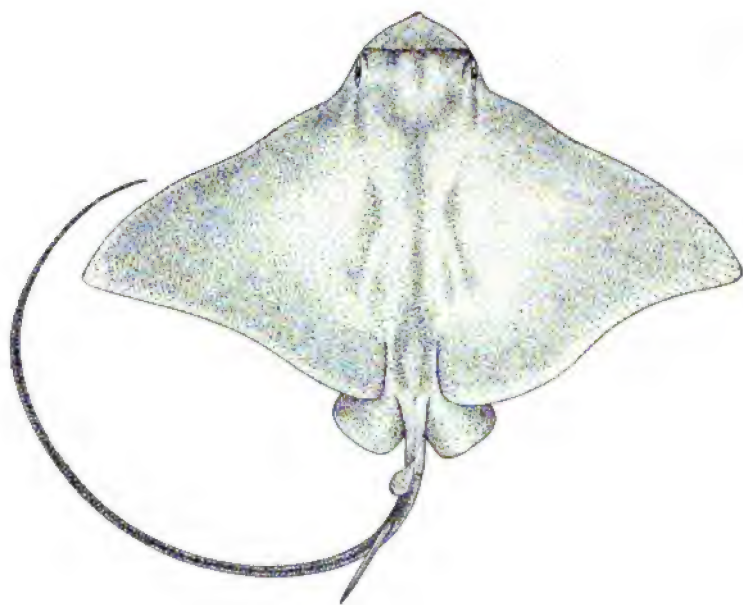


WHIP STING RAY. *Dasybatus hastata* (De Kay).



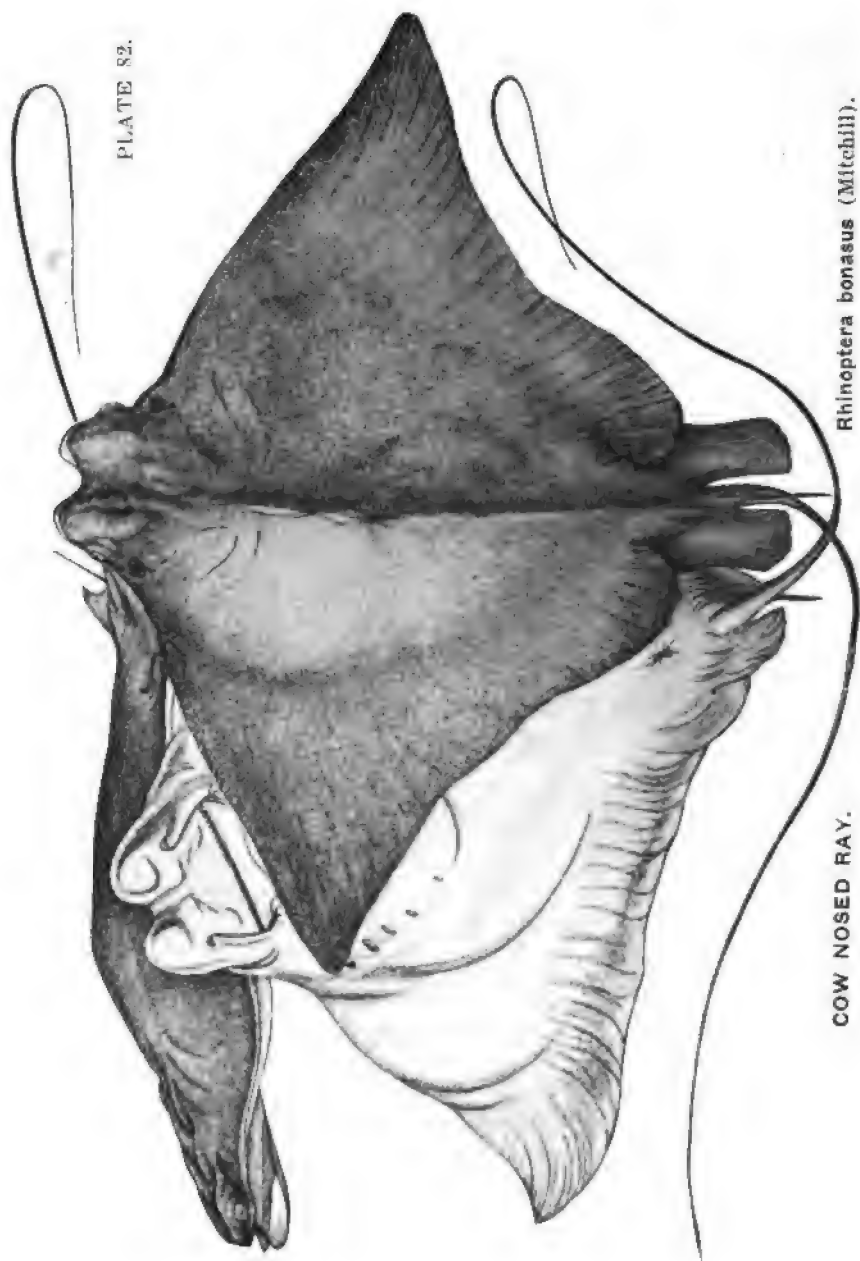


SAY'S STING RAY. *Dasybatus say* (Le Sueur).



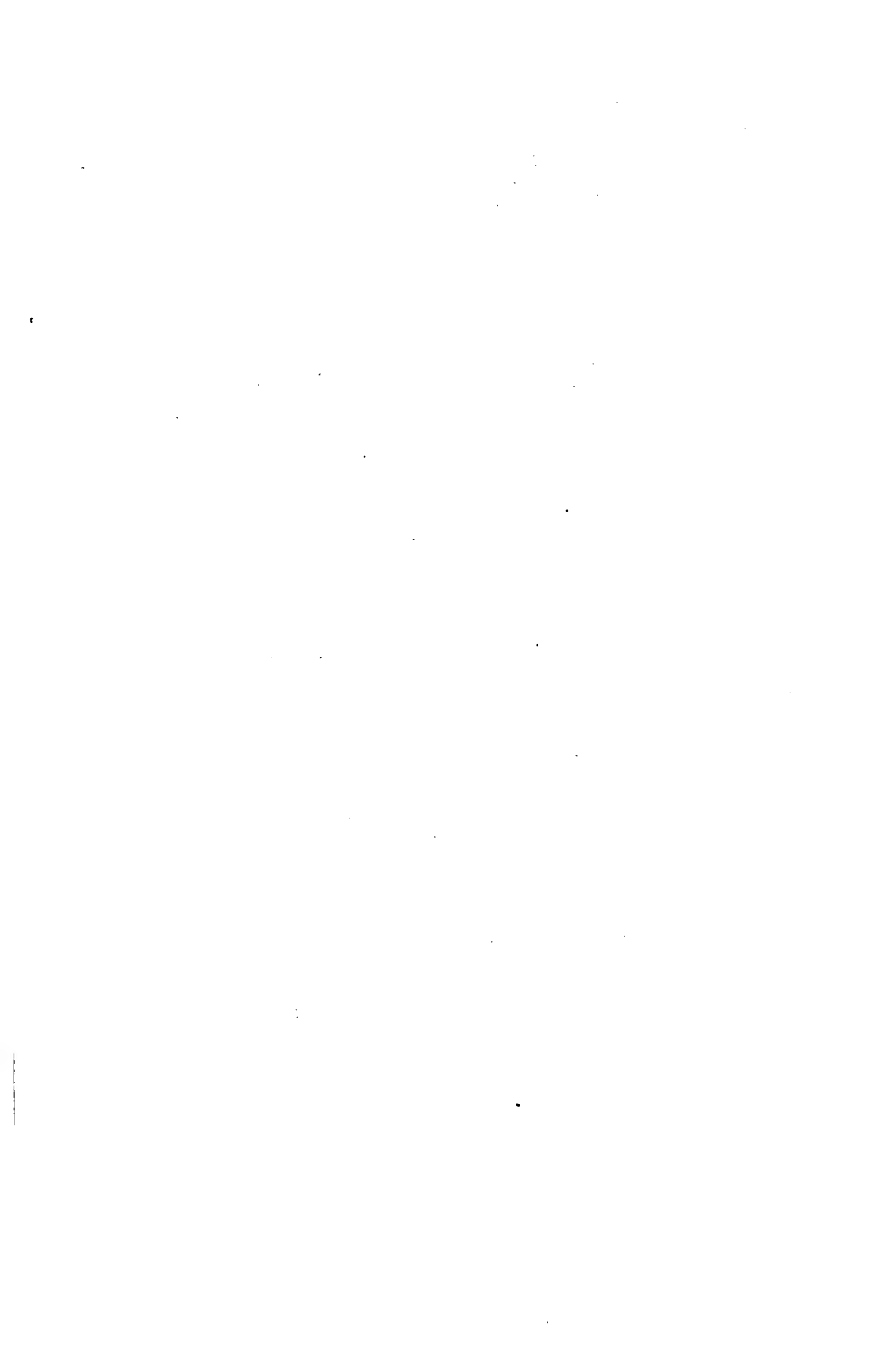
STINGAREE. *Myliobatis freminvillii* Le Sueur.

PLATE 82.



COW NOSED RAY.

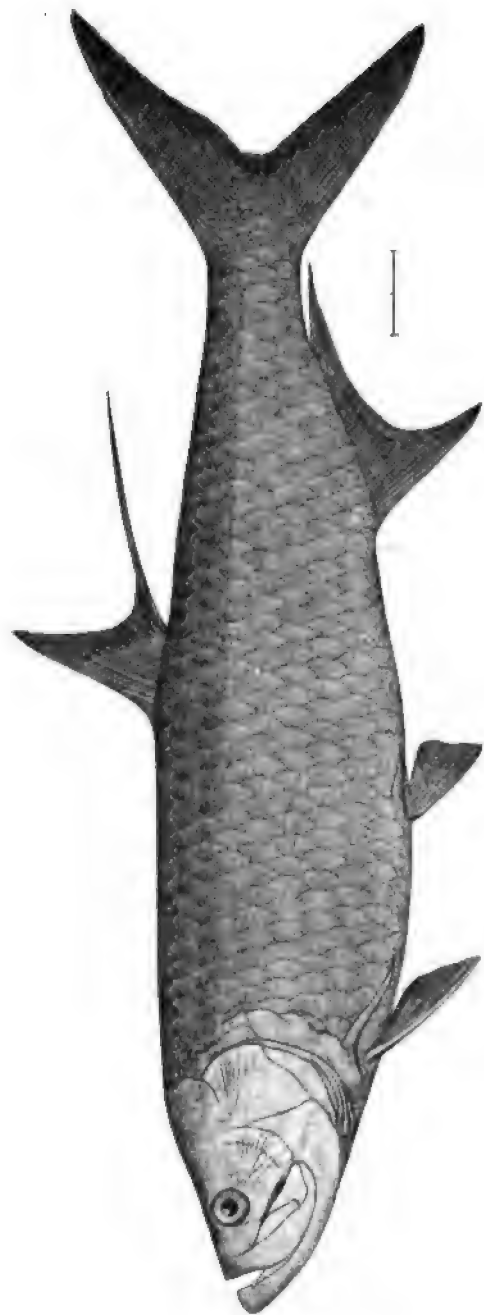
Rhinoptera bonasus (Mitchill).



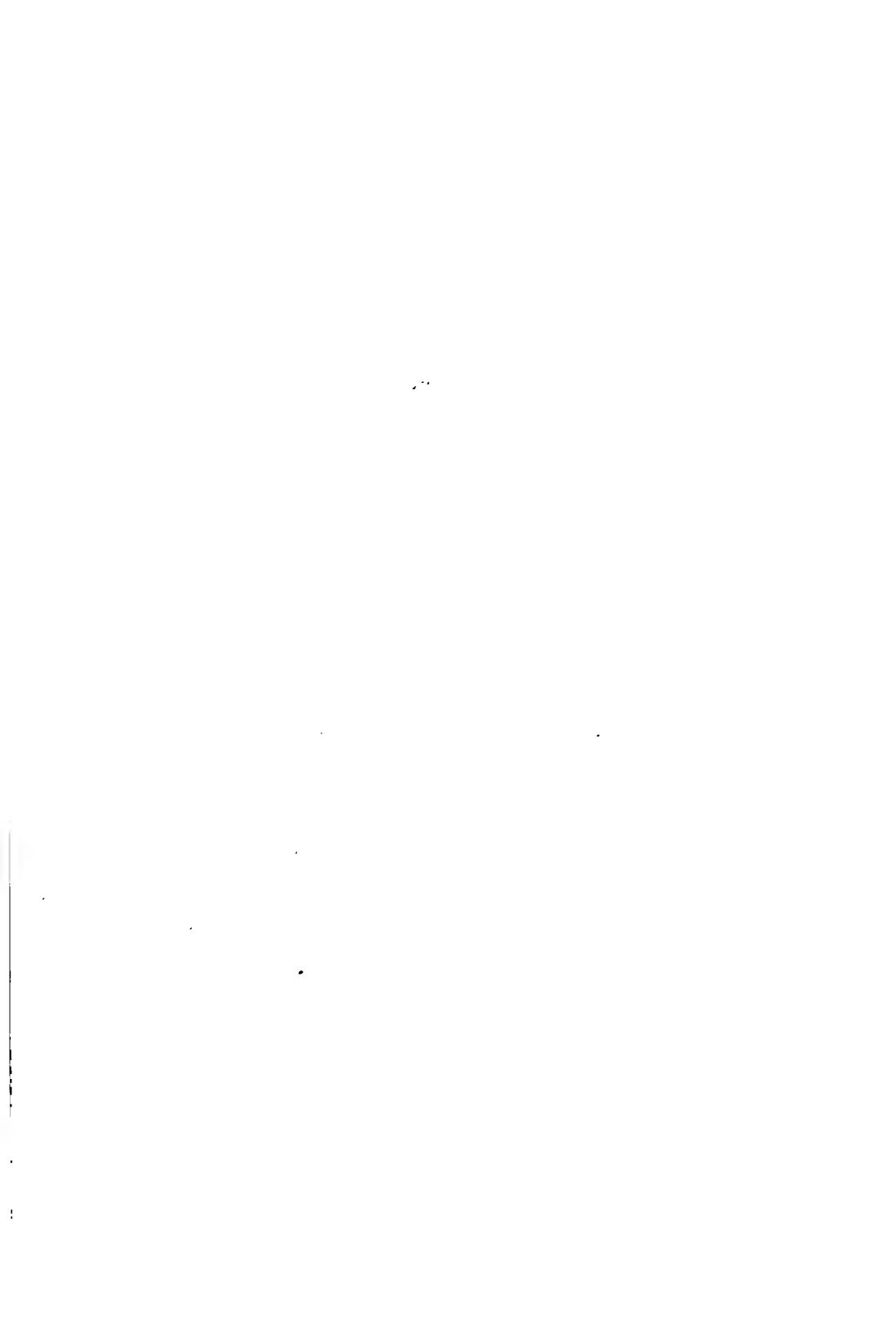


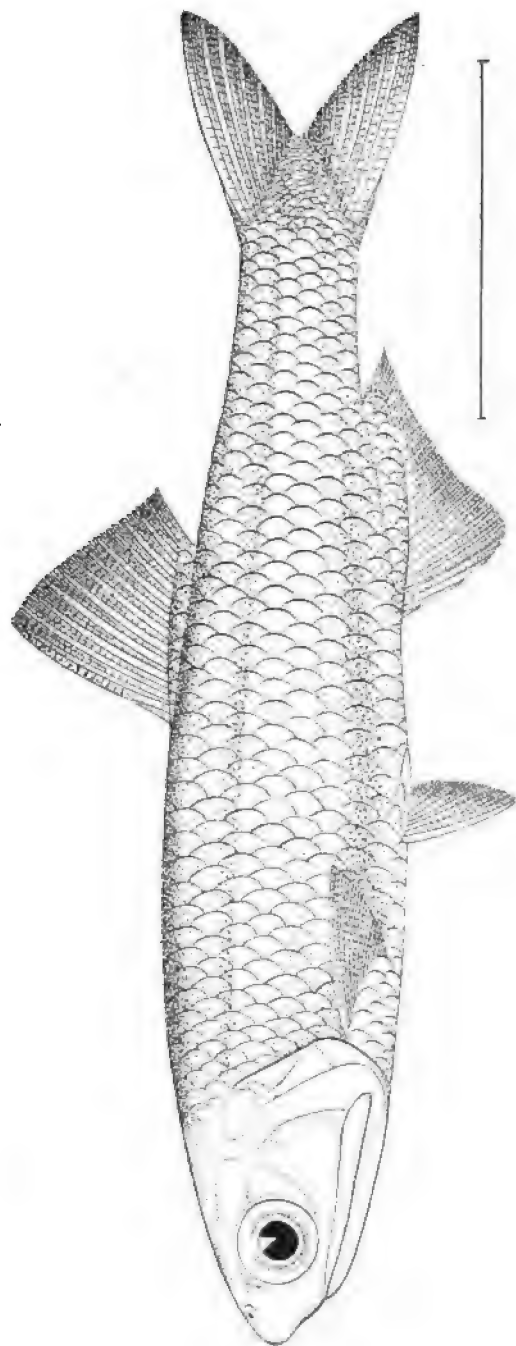
GAR PIKE. *Psalliosotomus osseus* (Linnæus).





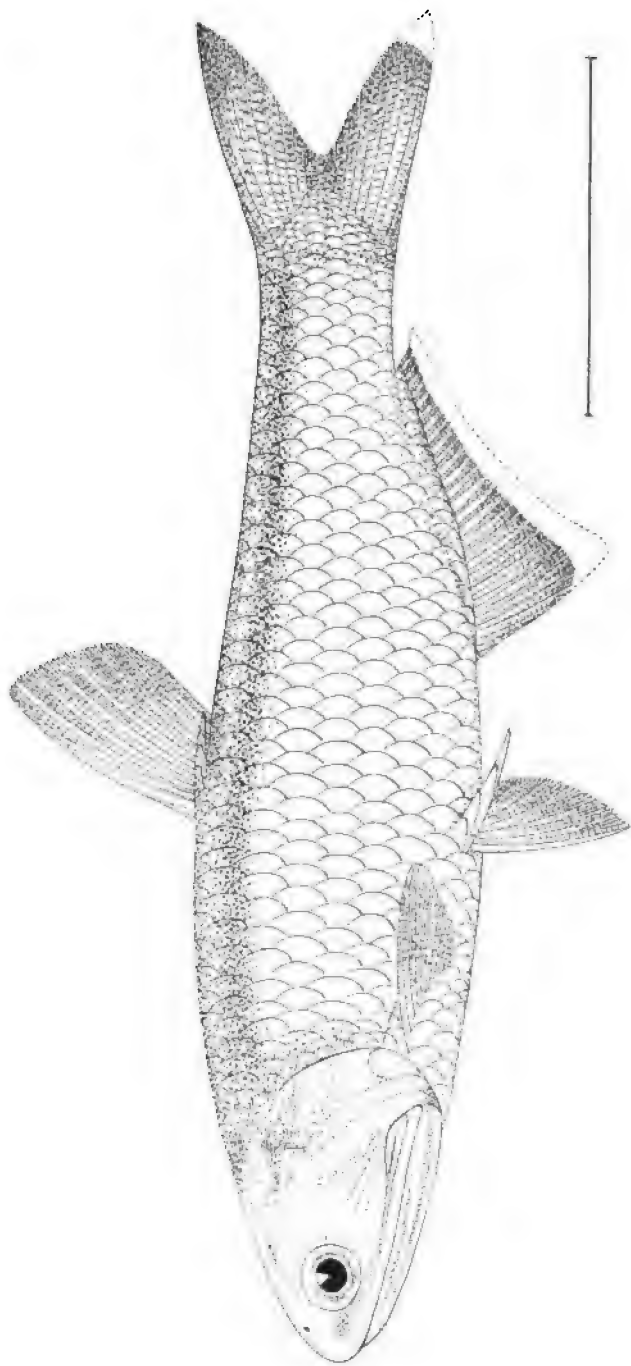
TARPON. *Tarpon atlanticus* (Valenciennes).





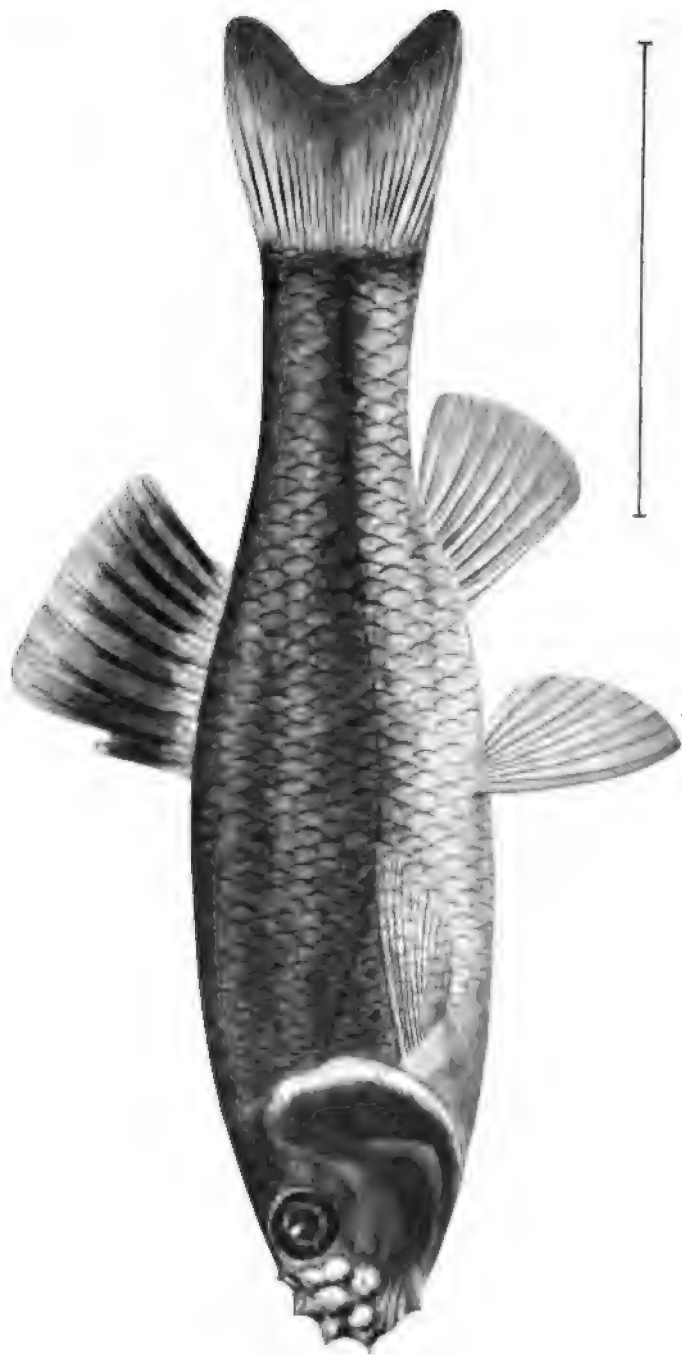
BROAD BANDED ANCHOVY. *Anchovia brownii* (Gmelin).



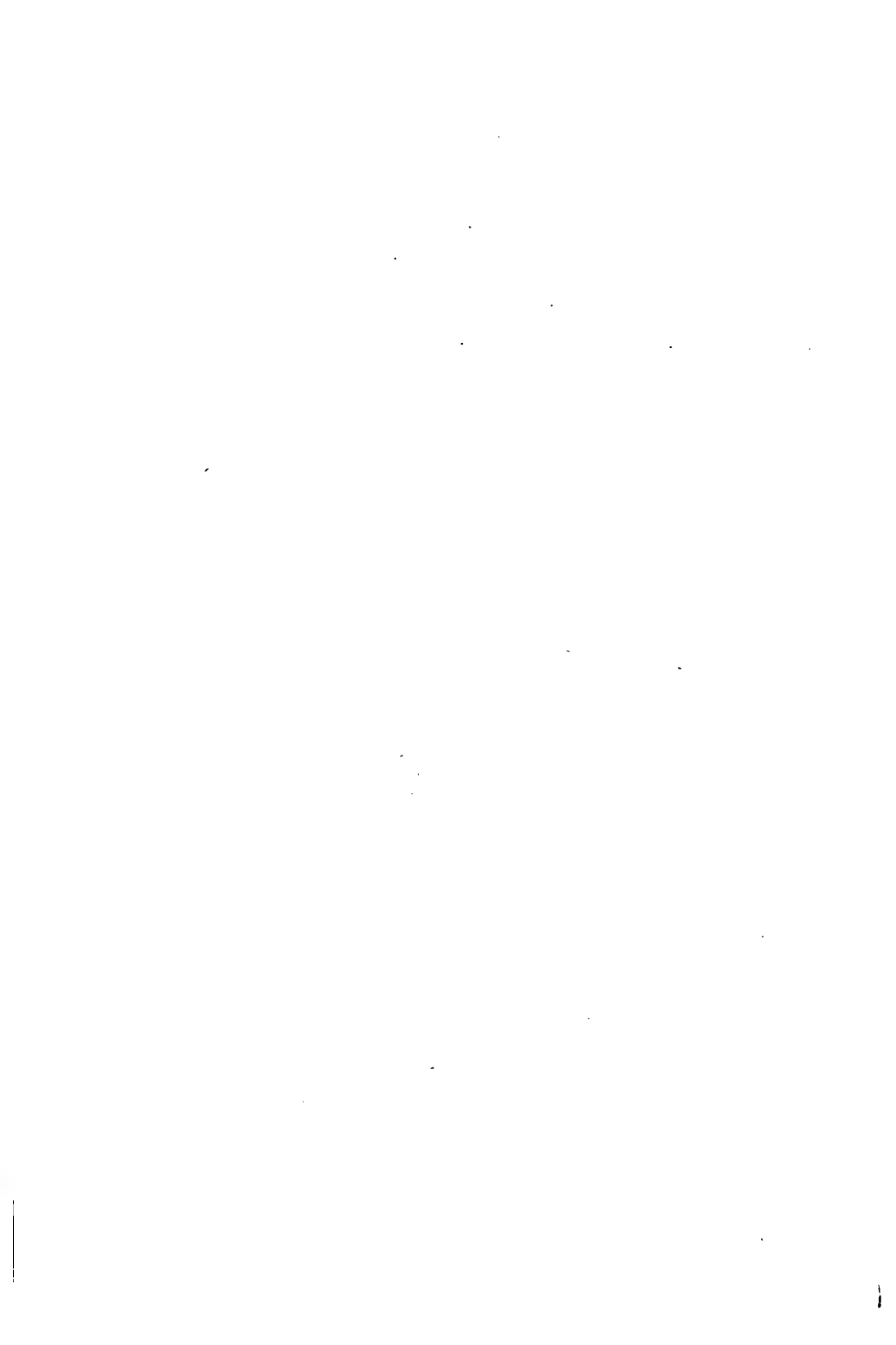


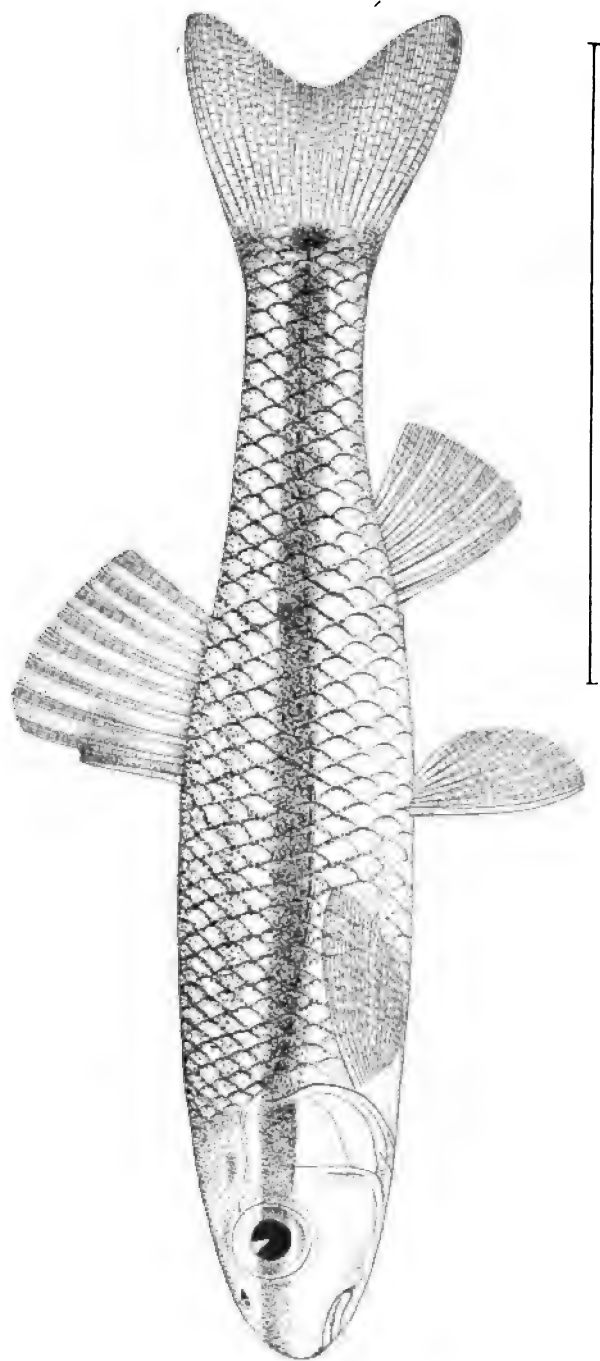
LONG FINNED ANCHOVY. *Anchovia duodecim* (Cope).

PLATE 87.

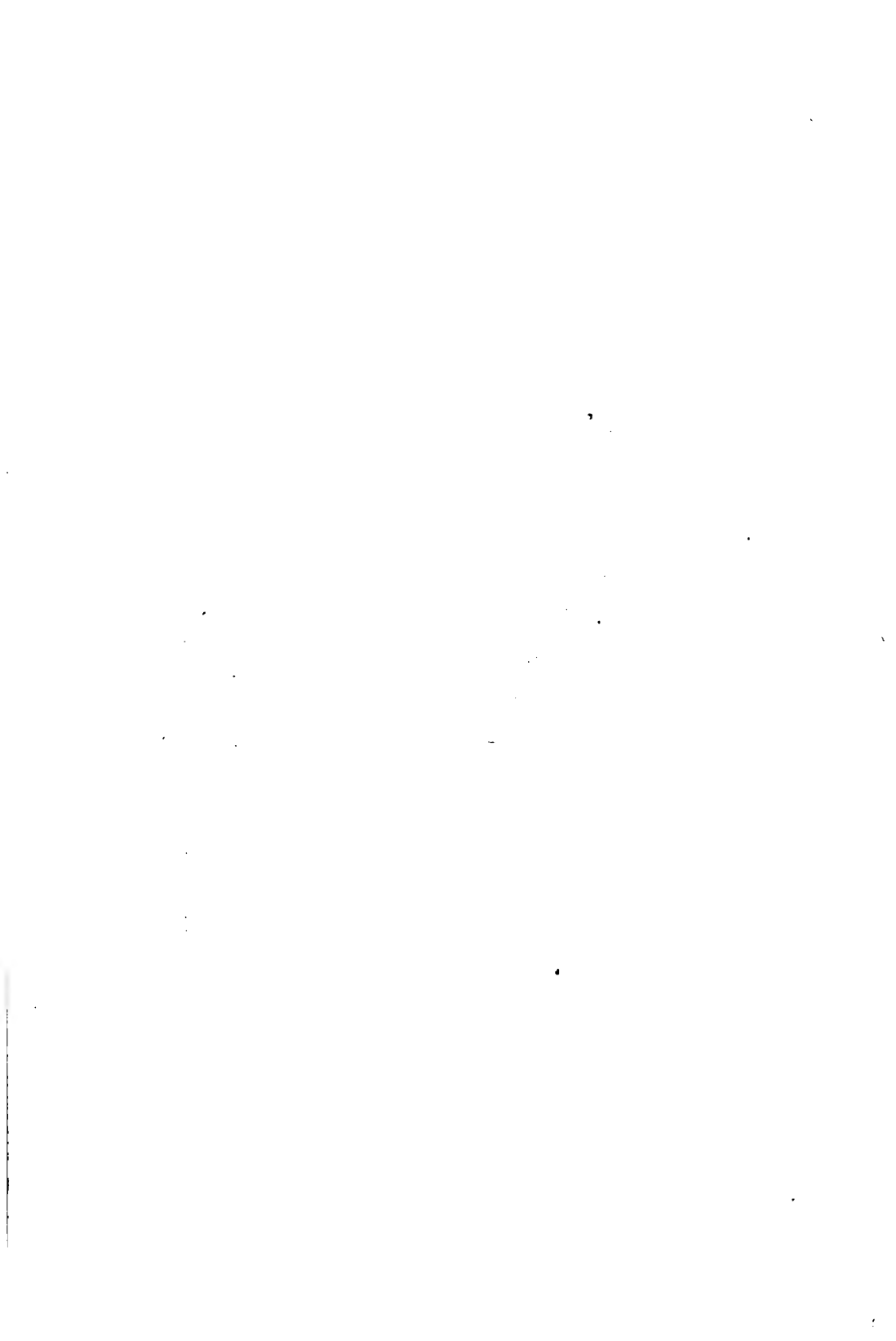


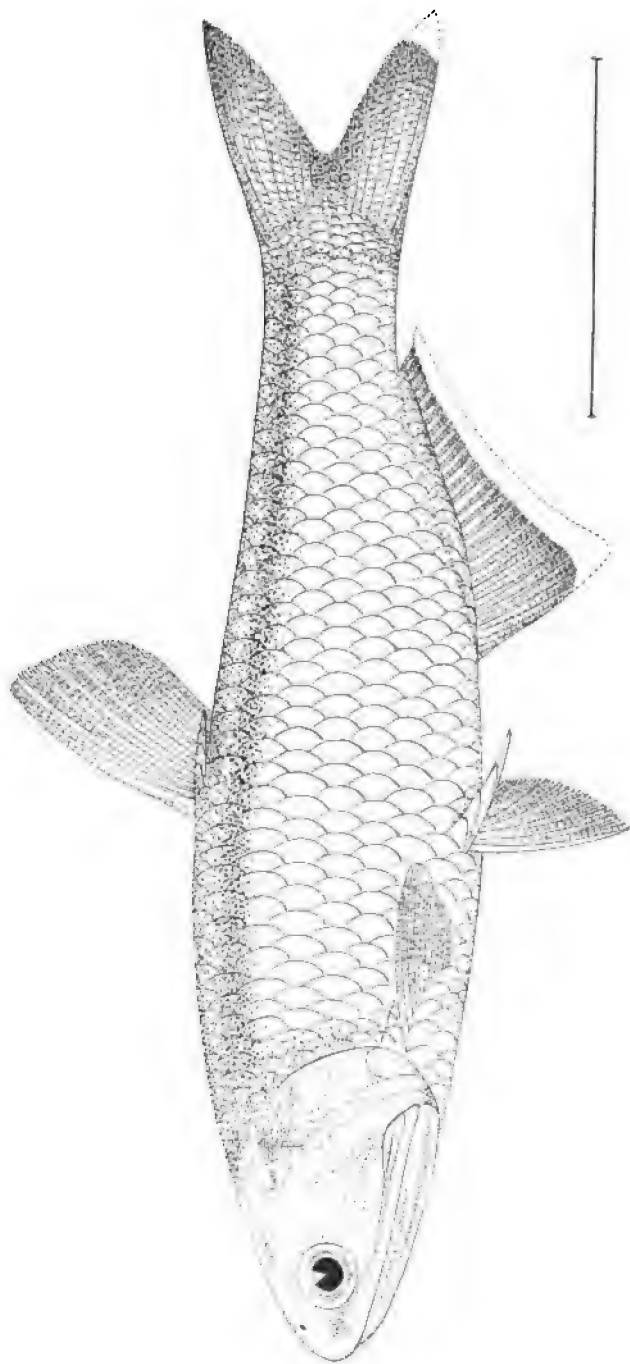
BLUNT NOSED MINNOW. *Pimephales notatus* (Rafinesque). (Adult.)



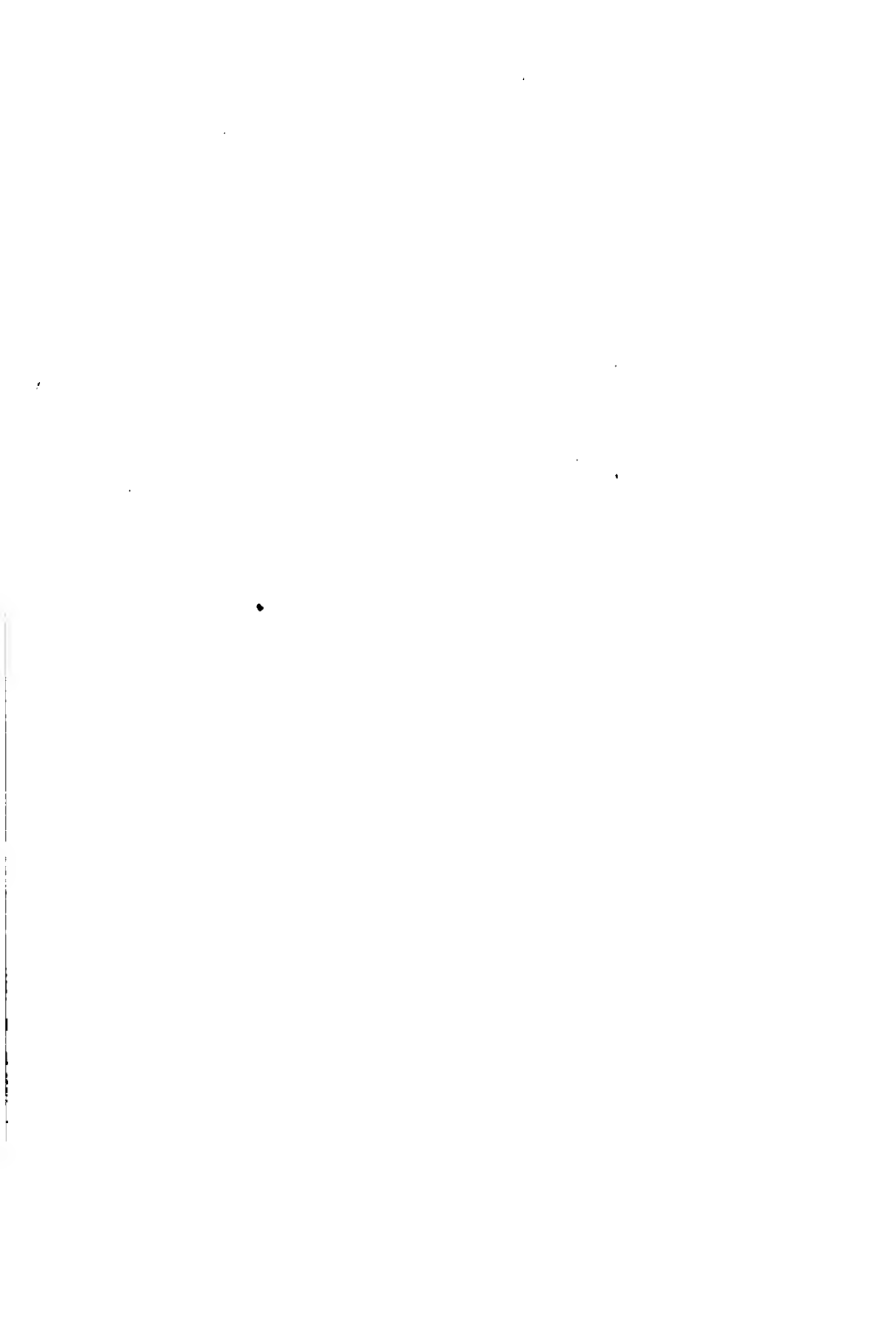


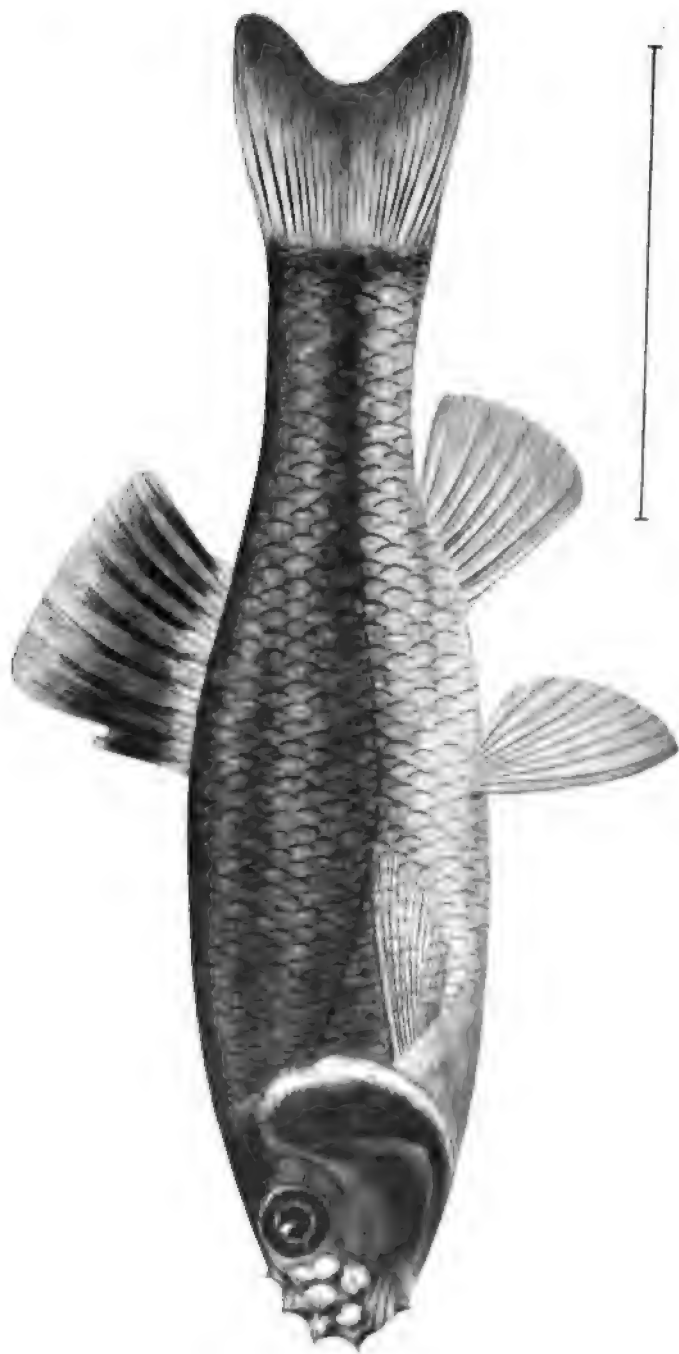
BLUNT NOSED MINNOW. *Pimephales notatus* (Rafinesque). (Young.)



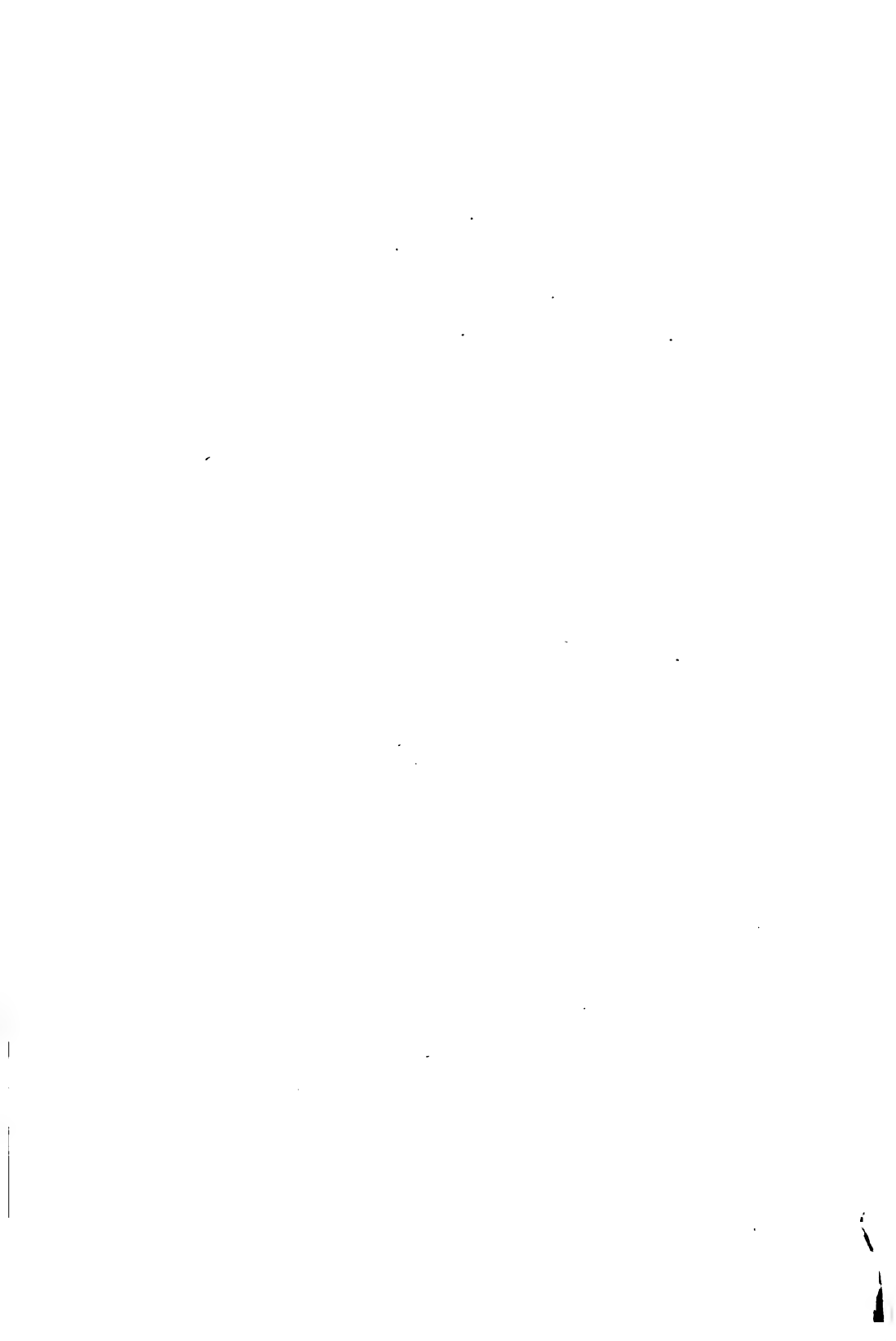


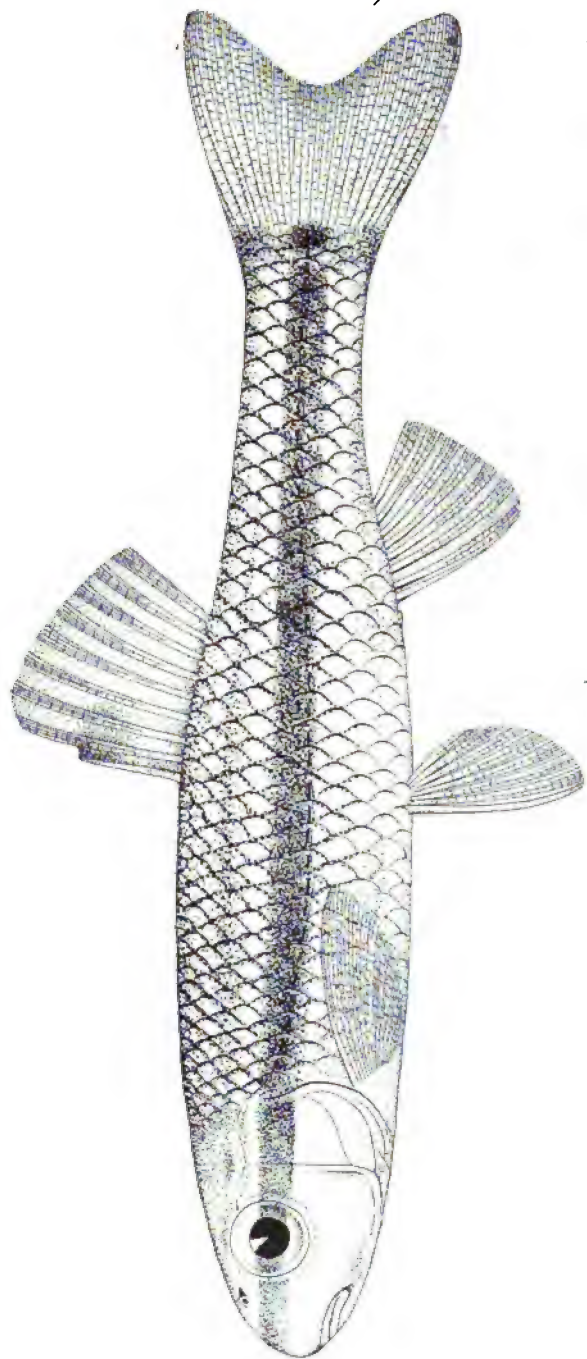
LONG FINNED ANCHOVY. *Anchovia duodecim* (Cope).





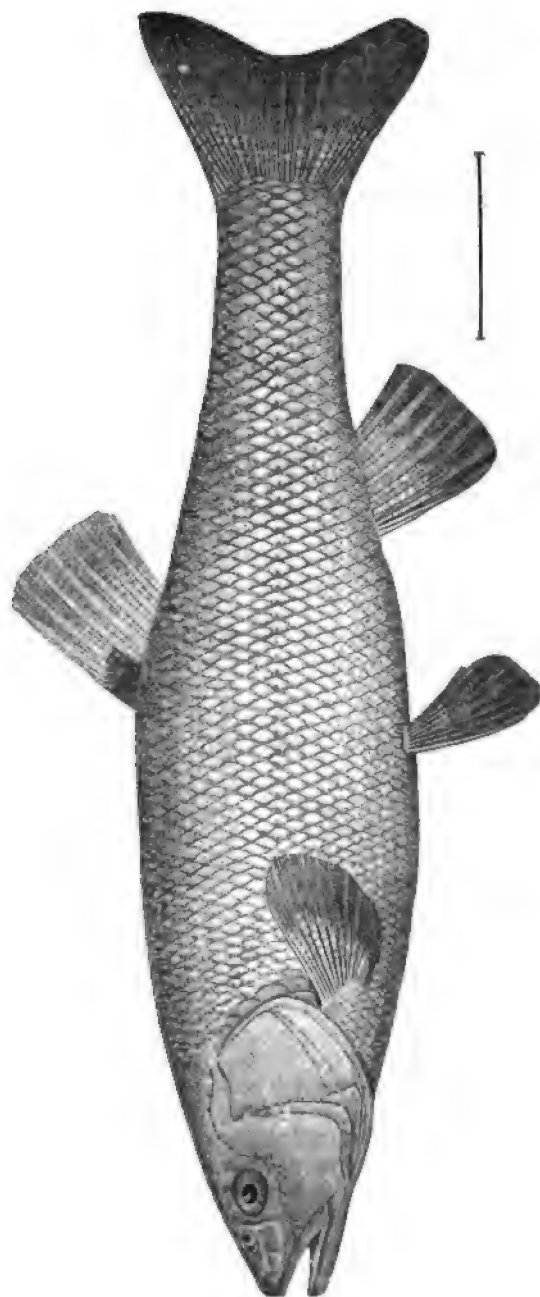
BLUNT NOSED MINNOW. *Pimephales notatus* (Rafinesque). (Adult.)



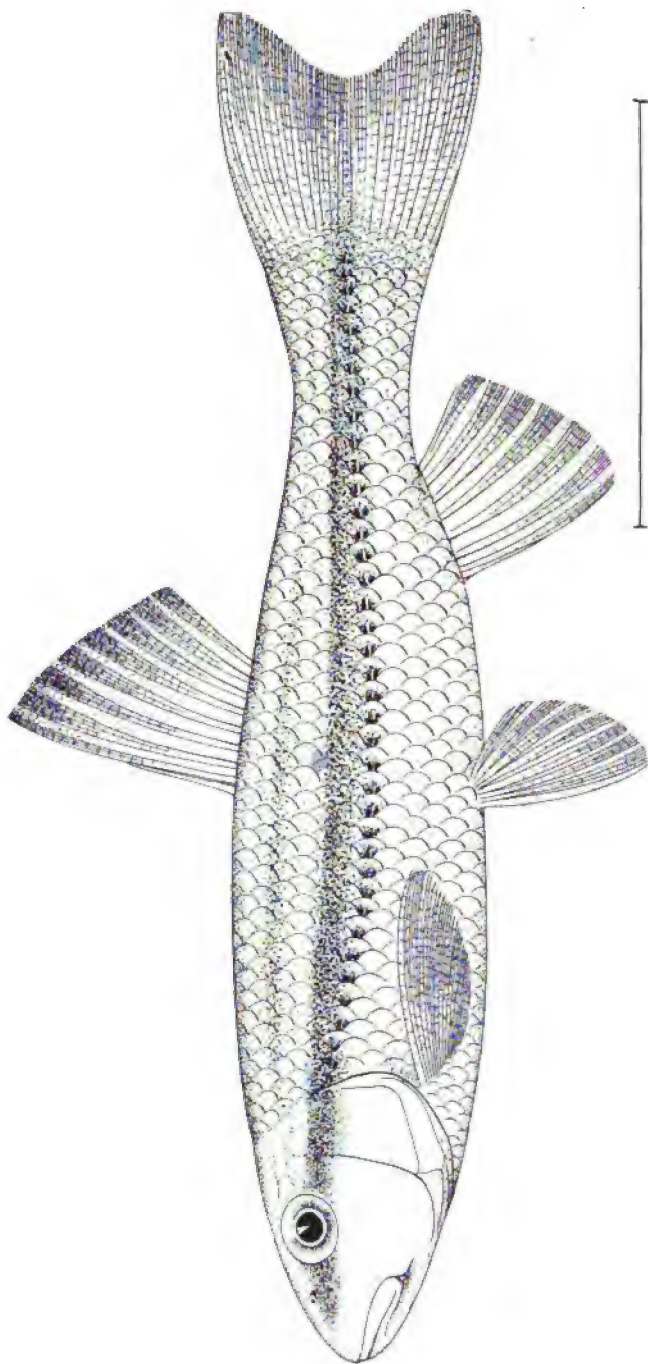


BLUNT NOSED MINNOW. *Pimephales notatus* (Rafinesque). (Young.)

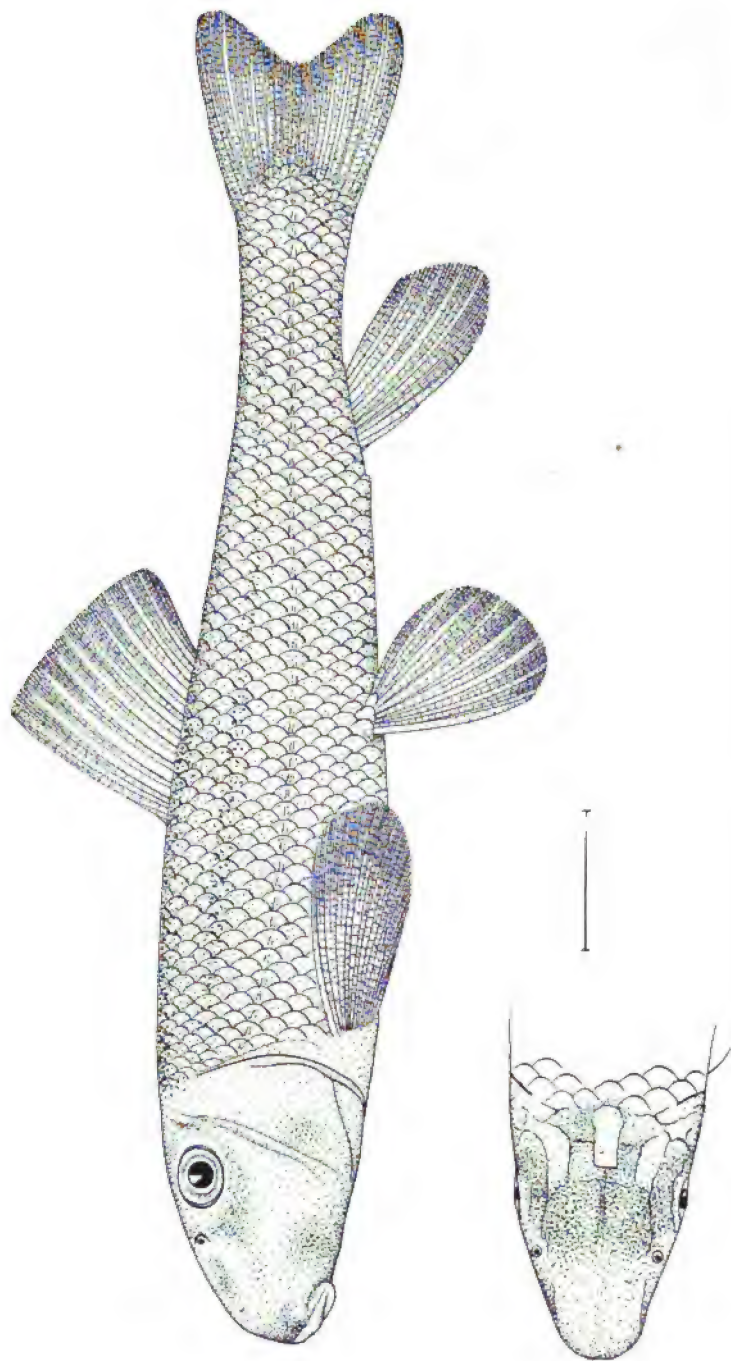




CHUB. *Semotilus atromaculatus* (Mitchill).

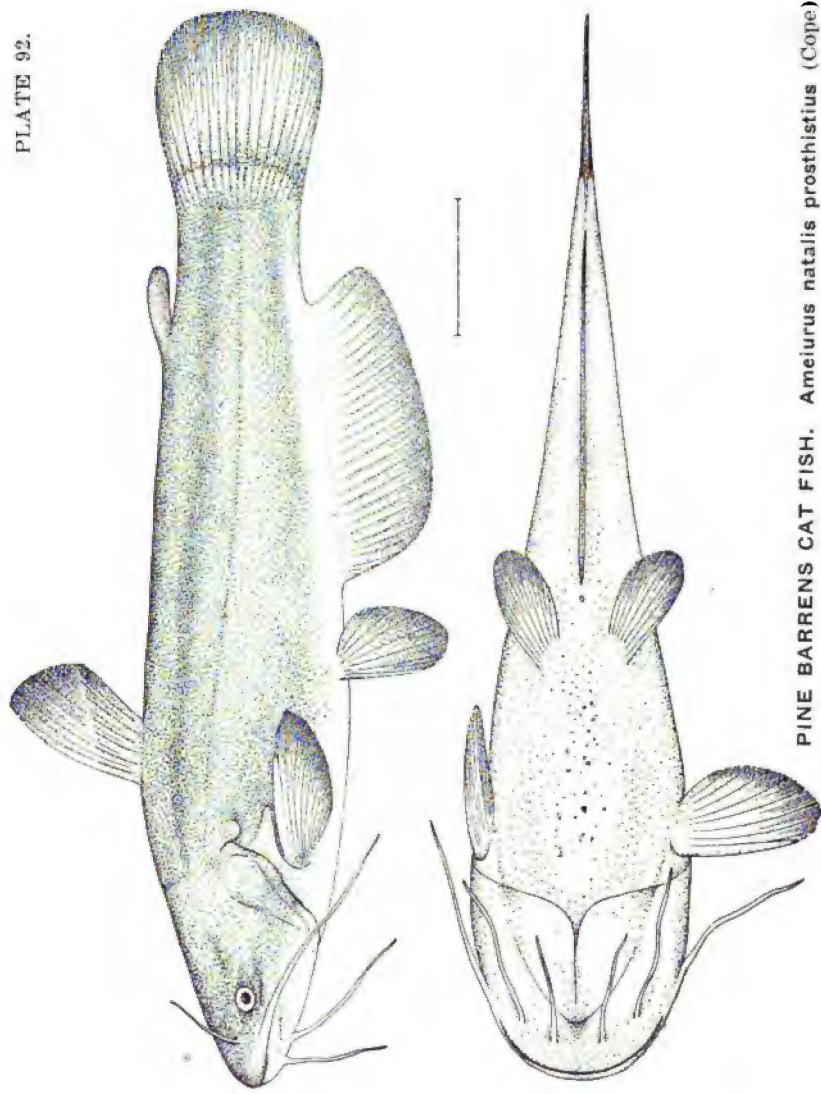


HORNY HEAD. *Hybopsis kentuckiensis* (Rafinesque). (Half-grown.)

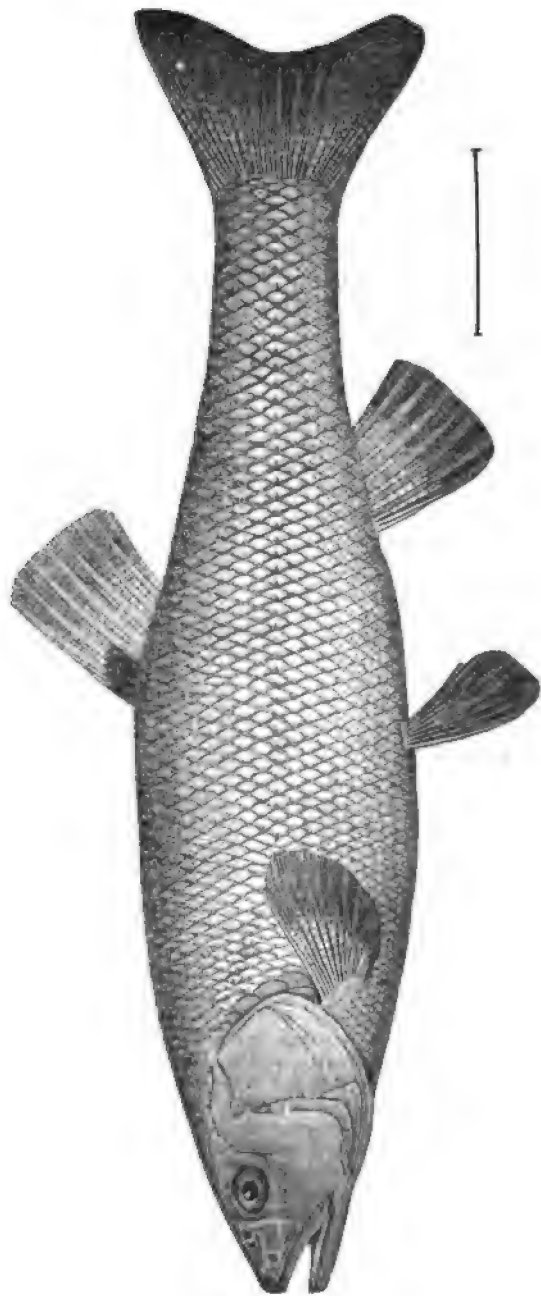


BLACK SUCKER. *Catostomus nigricans* (Le Sueur).





PINE BARRENS CAT FISH. *Amelurus natalis prosthistioides* (Cope).



CHUB. *Semotilus atromaculatus* (Mitchill).



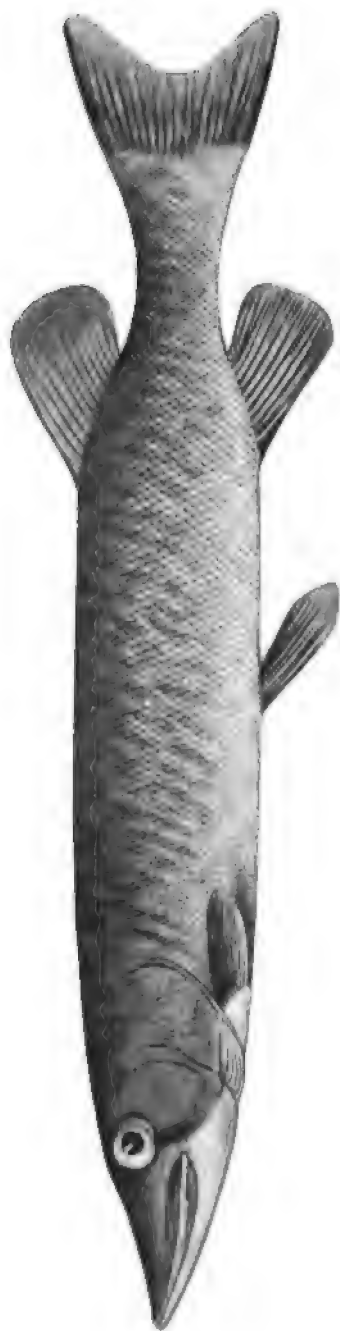
PLATE 93.



BANDED PICKEREL. *Esox americanus* (Gmelin).



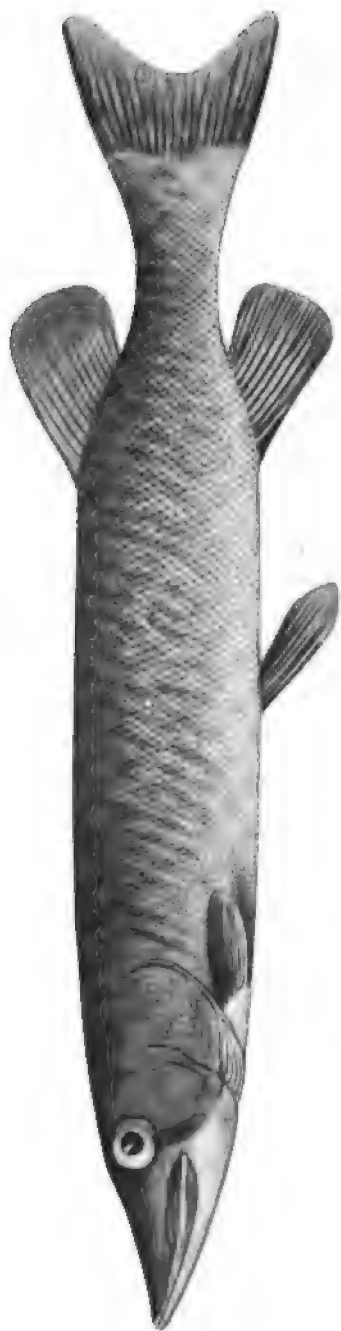
PLATE 93.



BANDED PICKEREL. *Esox americanus* (Gmelin).



PLATE 93.



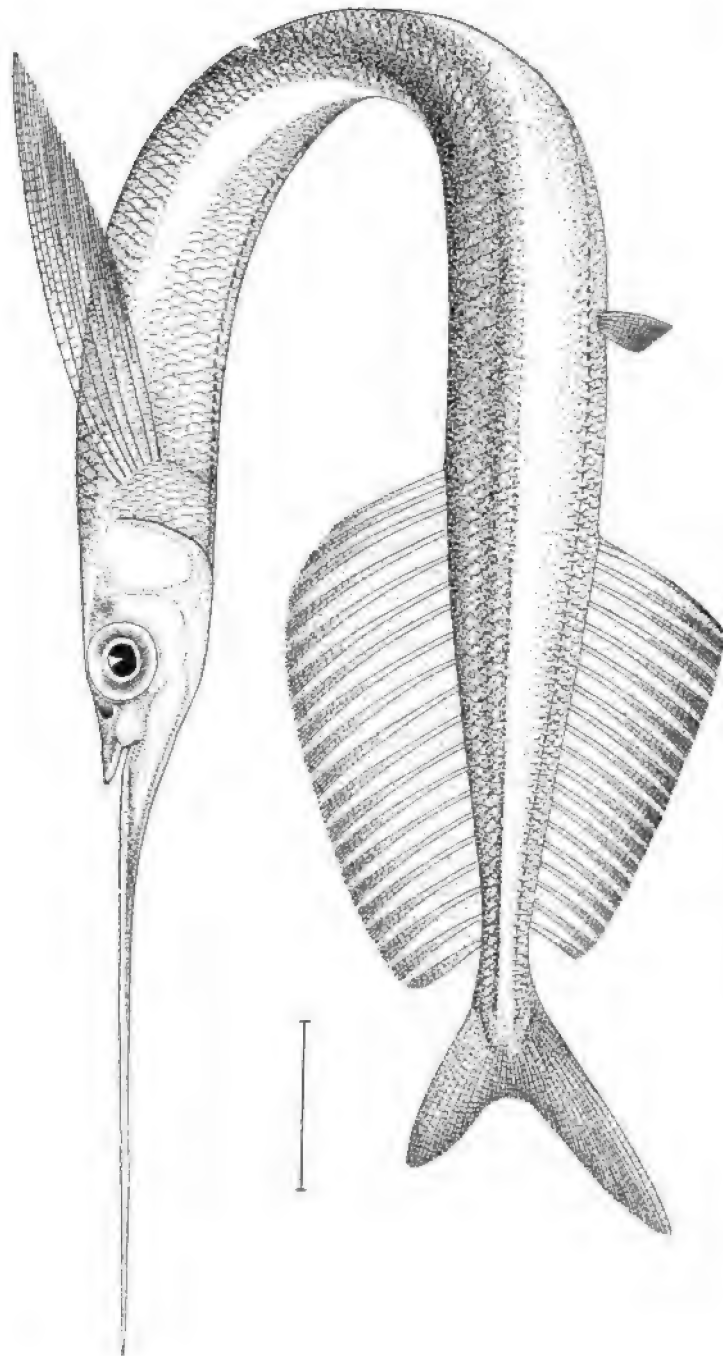
BANDED PICKEREL. *Esox americanus* (Gmelin).



PLATE 93.

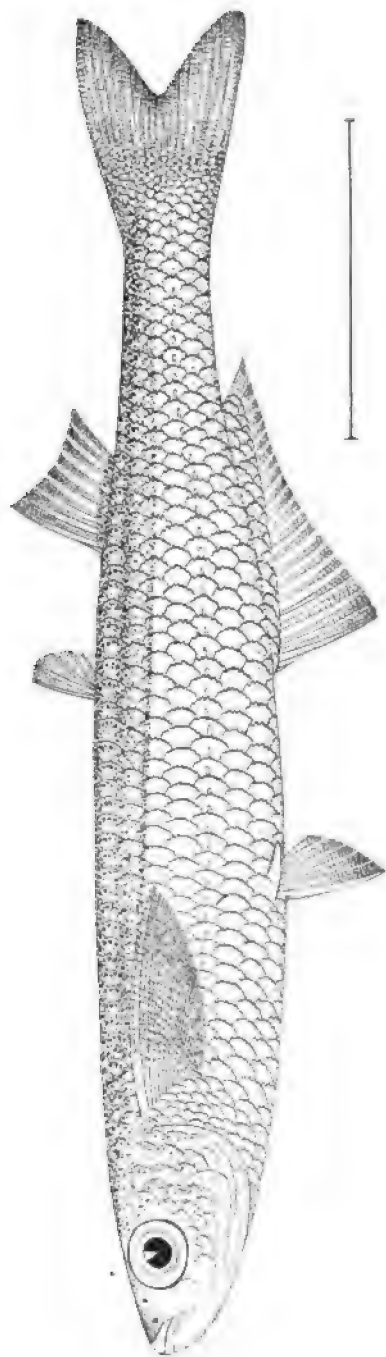


BANDED PICKEREL. *Esox americanus* (Gmelin).



RIBBON HALF BEAK. *Euleptorhamphus velox* (Poey).

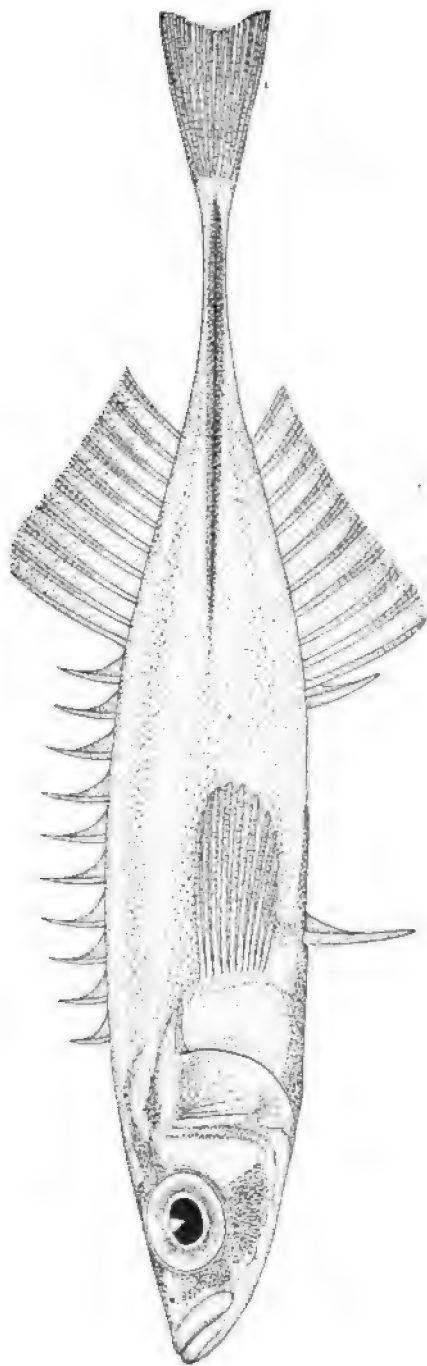
PLATE 95.



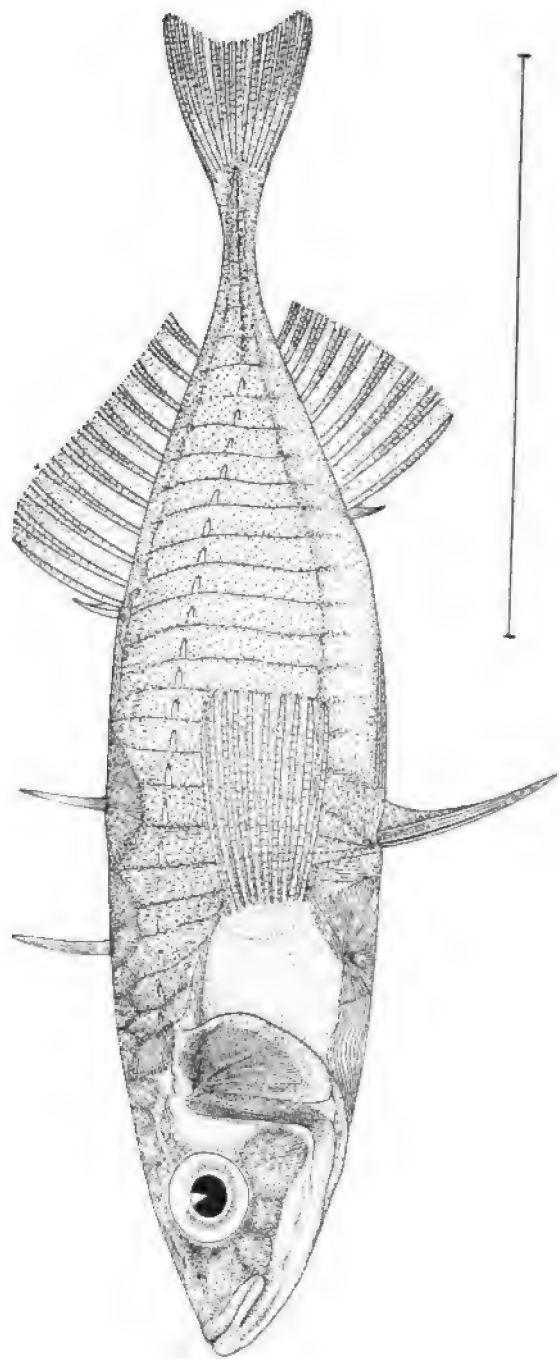
ROUGH SCALED SILVERSIDES. *Kirtlandia vagrans lacinata* (Jordan and Gilbert).



PLATE 96.

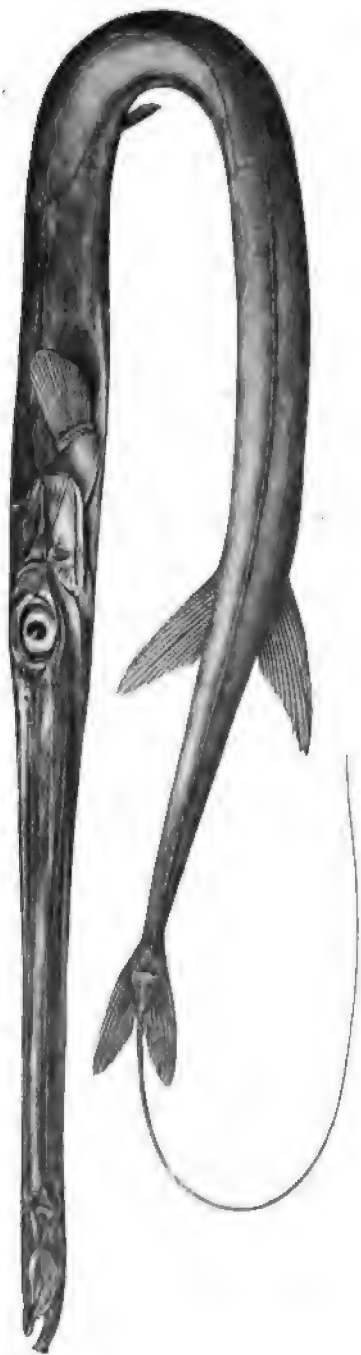


TEN SPINED STICKLEBACK. *Pygosteus pungitius* (Linnaeus).

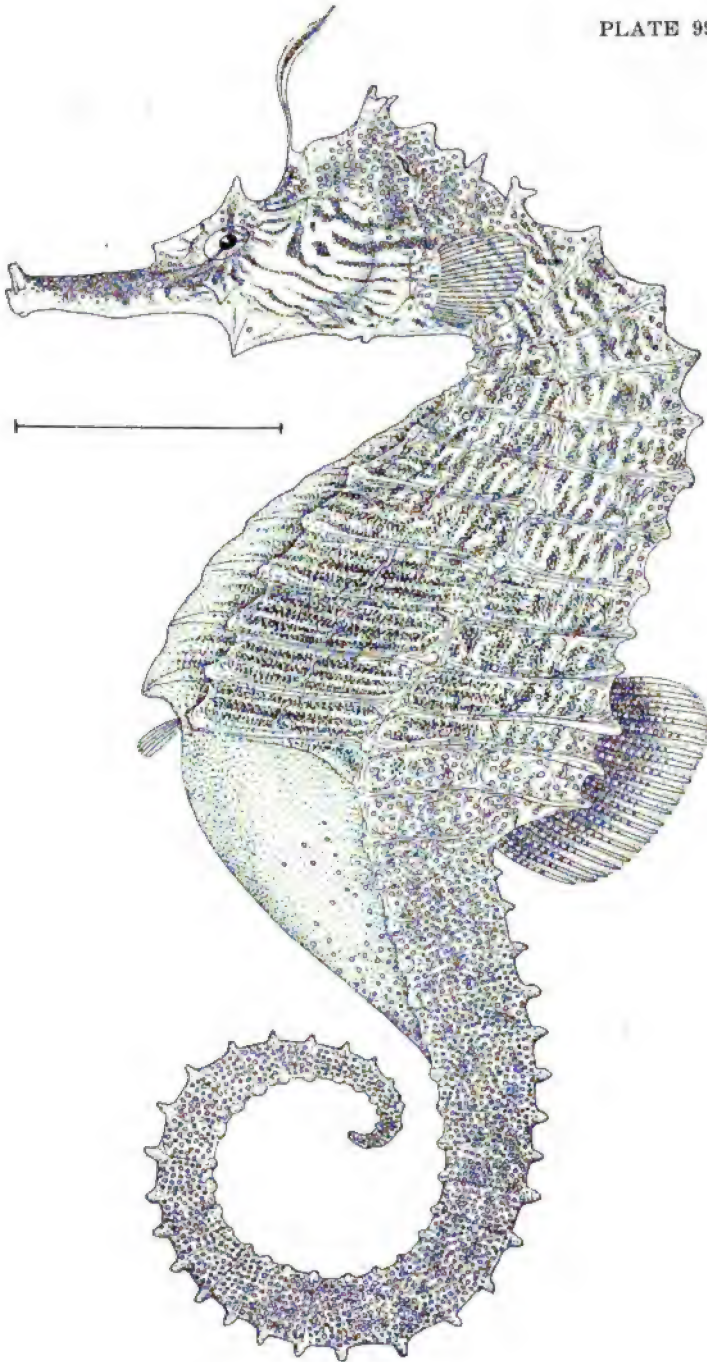


TWO SPINED STICKLEBACK. *Gasterosteus bispinosus* (Walbaum).



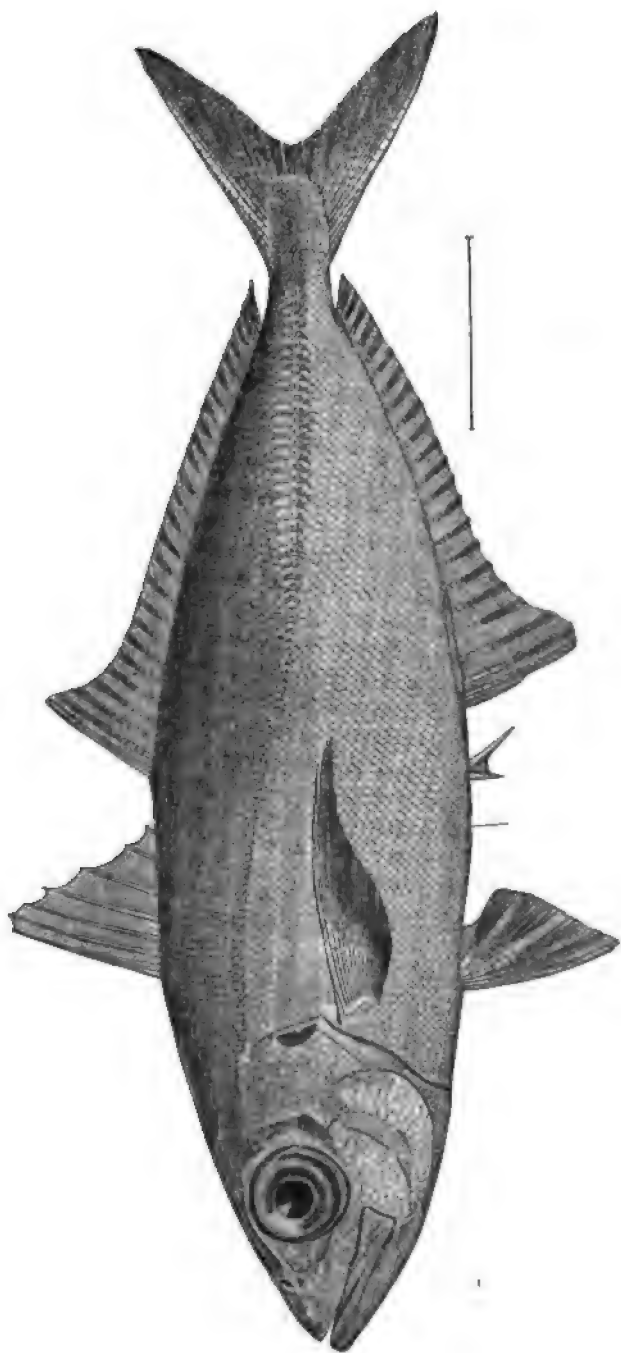


TRUMPET FISH. *Fistularia tabacaria* Linnæus.

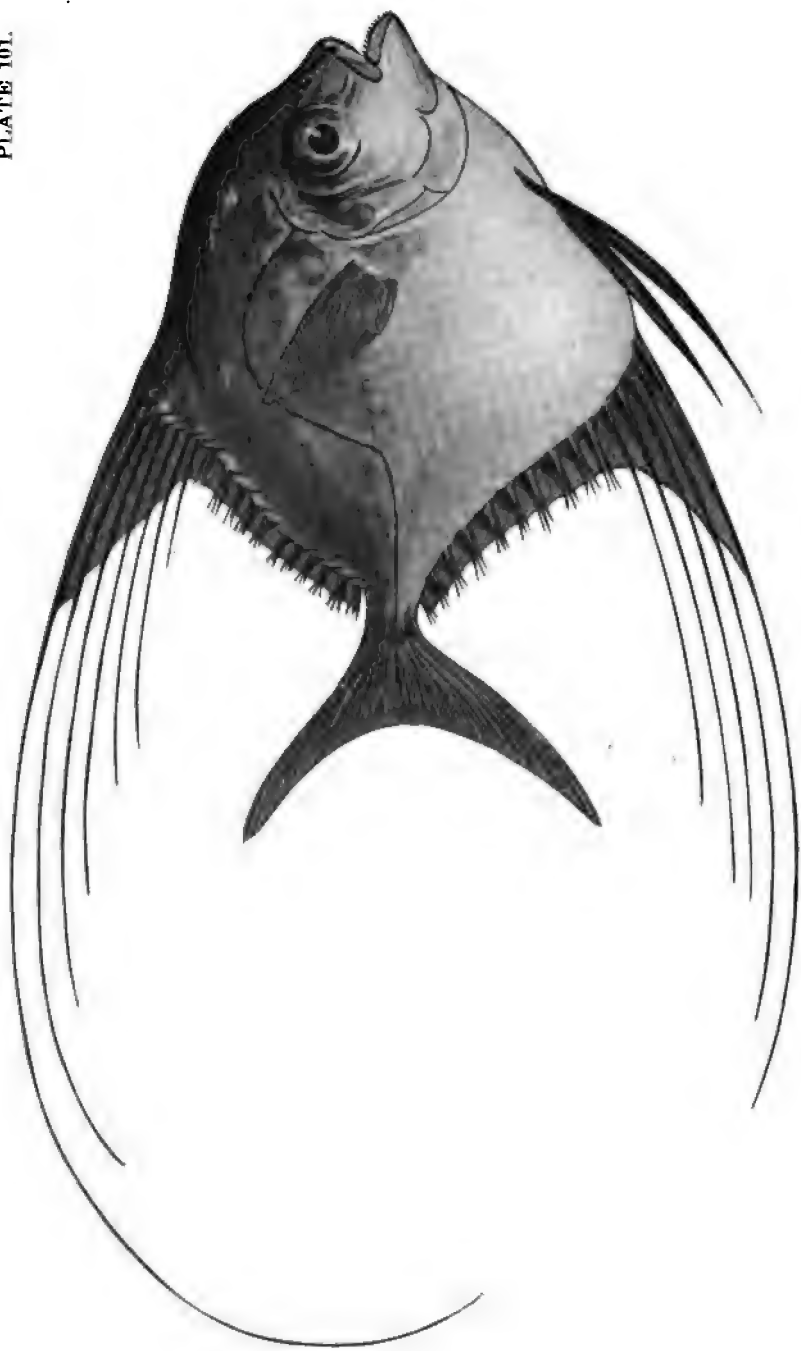


WHITE SPOTTED SEA HORSE. *Hippocampus punctulatus* Guichenot.

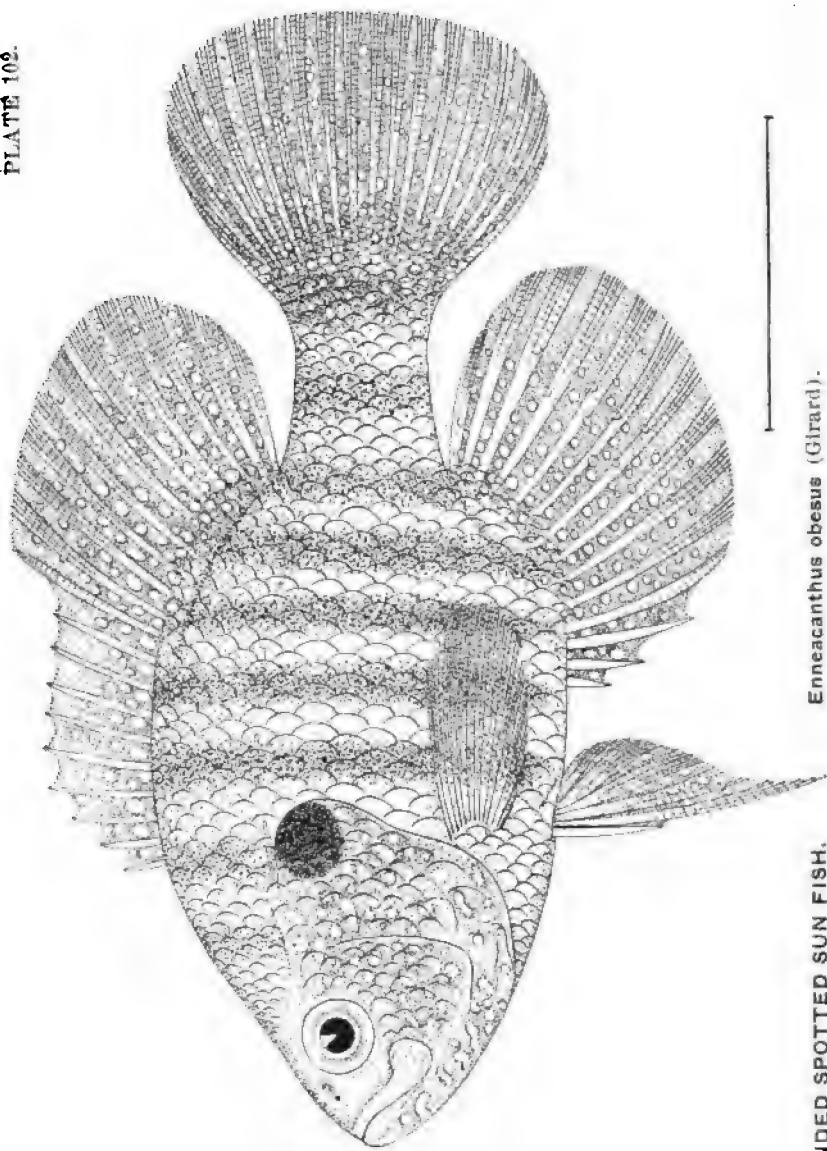




GOGGLE EYE SCAD. *Trachurus crumenophthalmus* (Bloch).



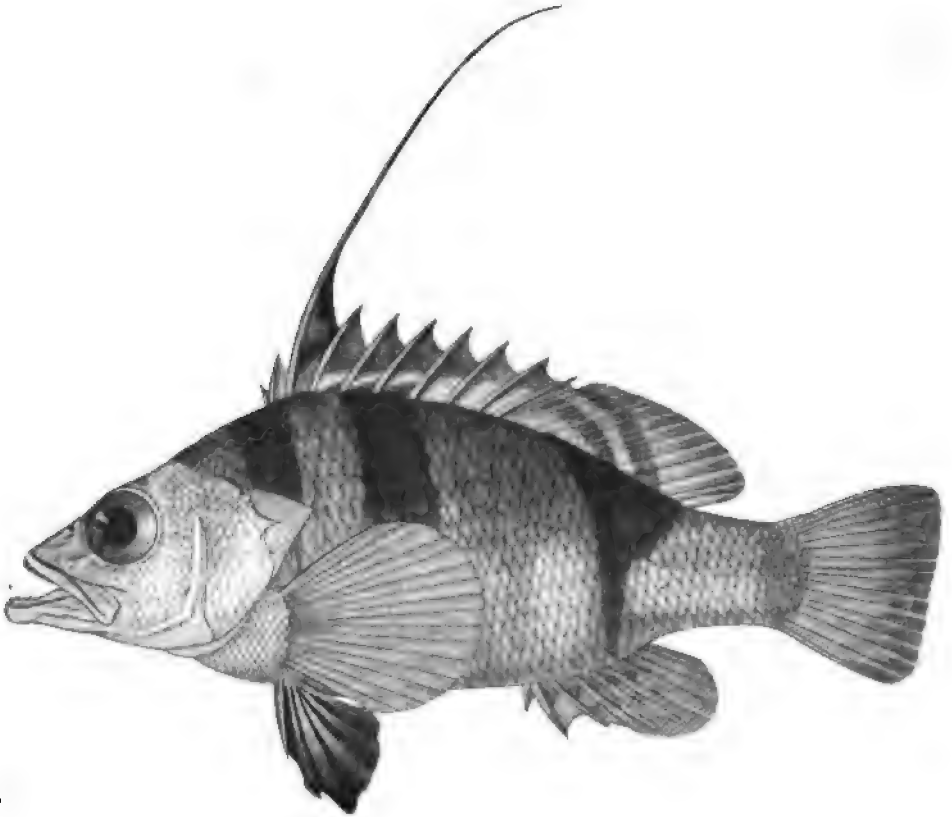
THREAD MACKEREL. *Blepharis crinitus* (Mitchill).



Enneacanthus obesus (Girard).

BANDED SPOTTED SUN FISH.





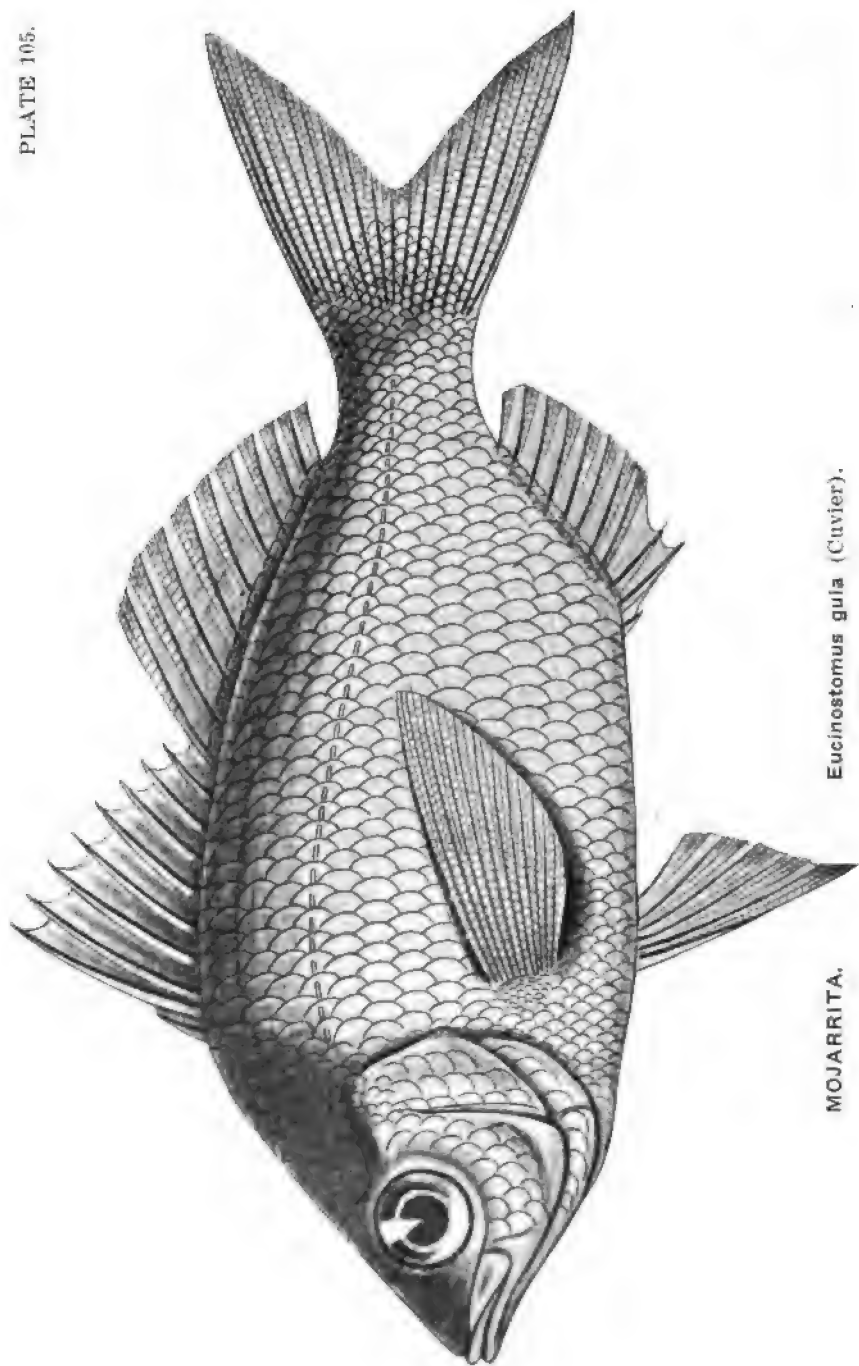
COACHMAN. *Dules auriga* Cuvier.





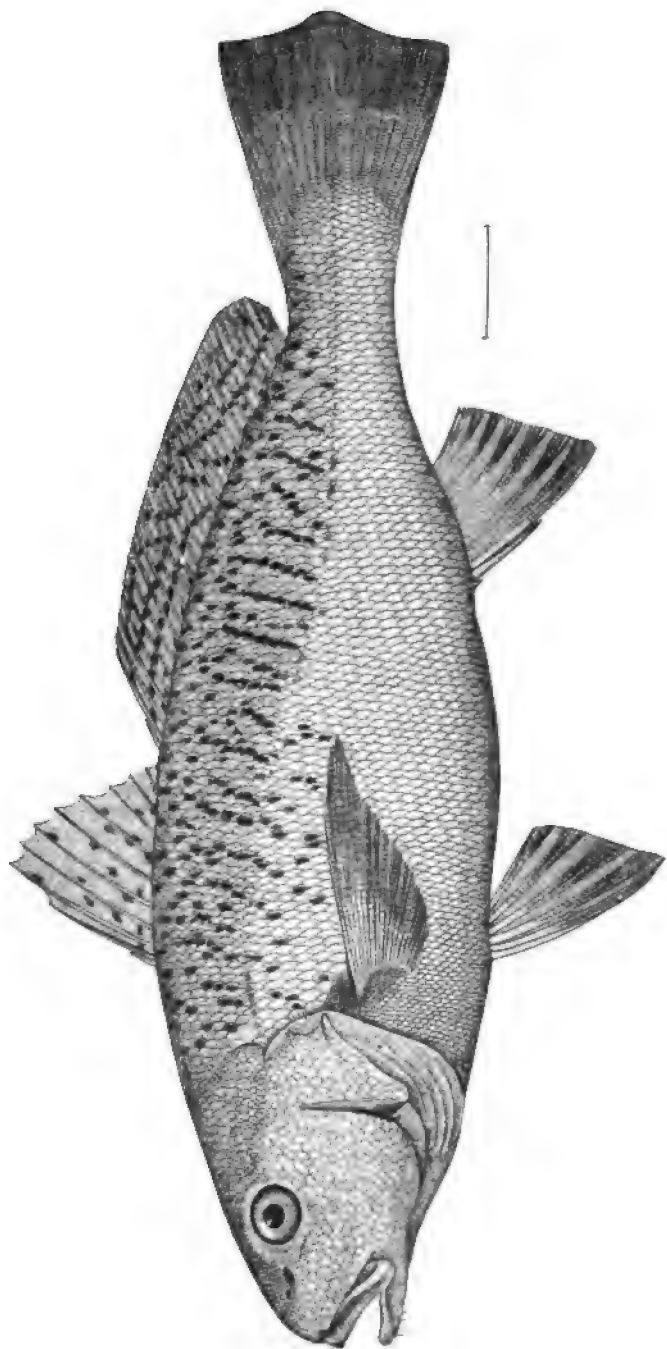
GRAY SNAPPER. *Lutianus griseus* (Linnaeus).





Eucinostomus gula (Cuvier).

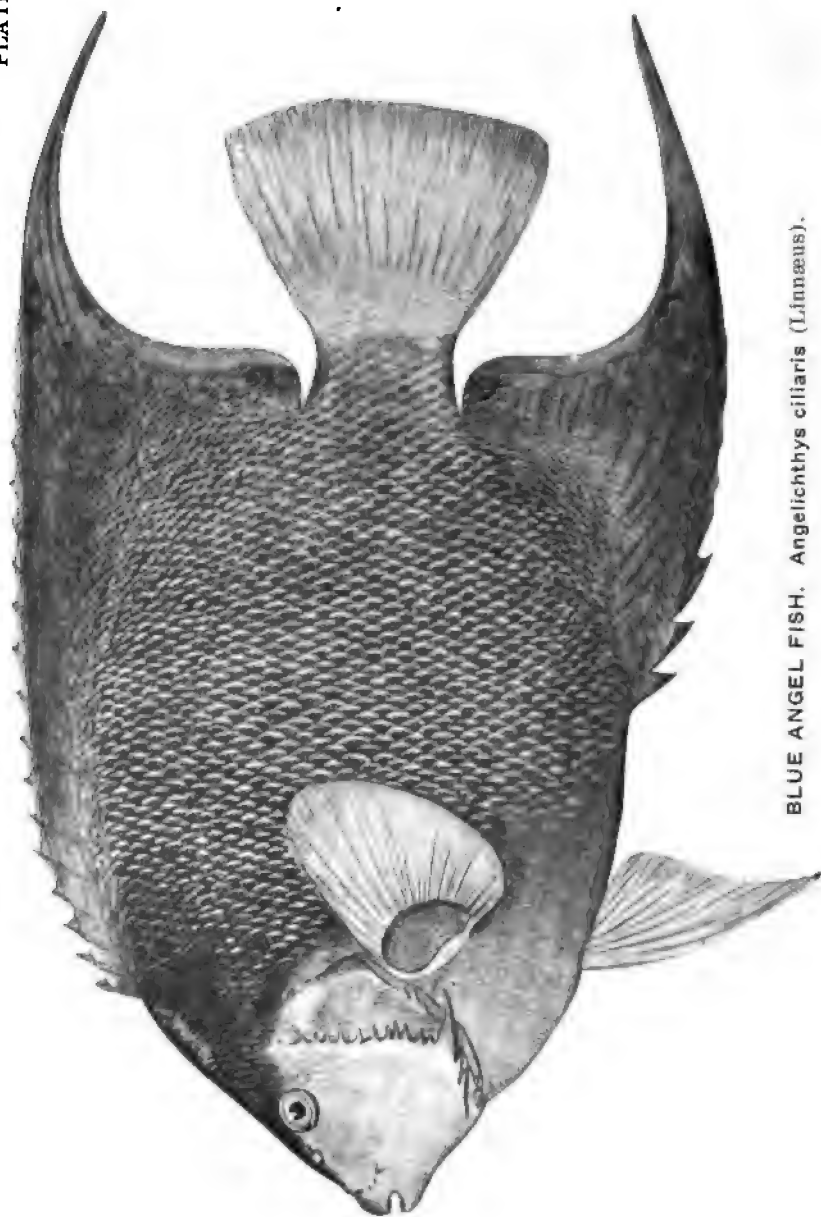
MOJARRITA.



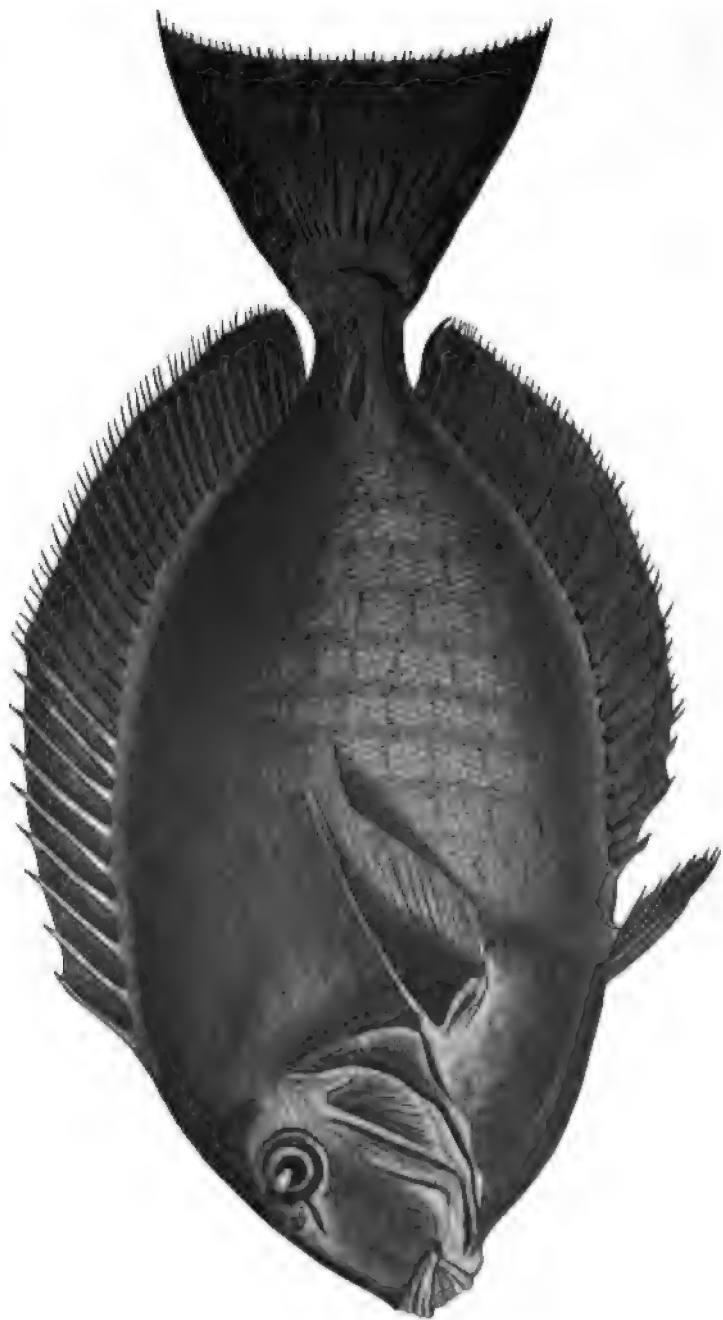
CROAKER. *Micropogon undulatus* (Linnaeus).



STREAKED BUTTERFLY FISH. *Chaetodon striatus* Linnæus.

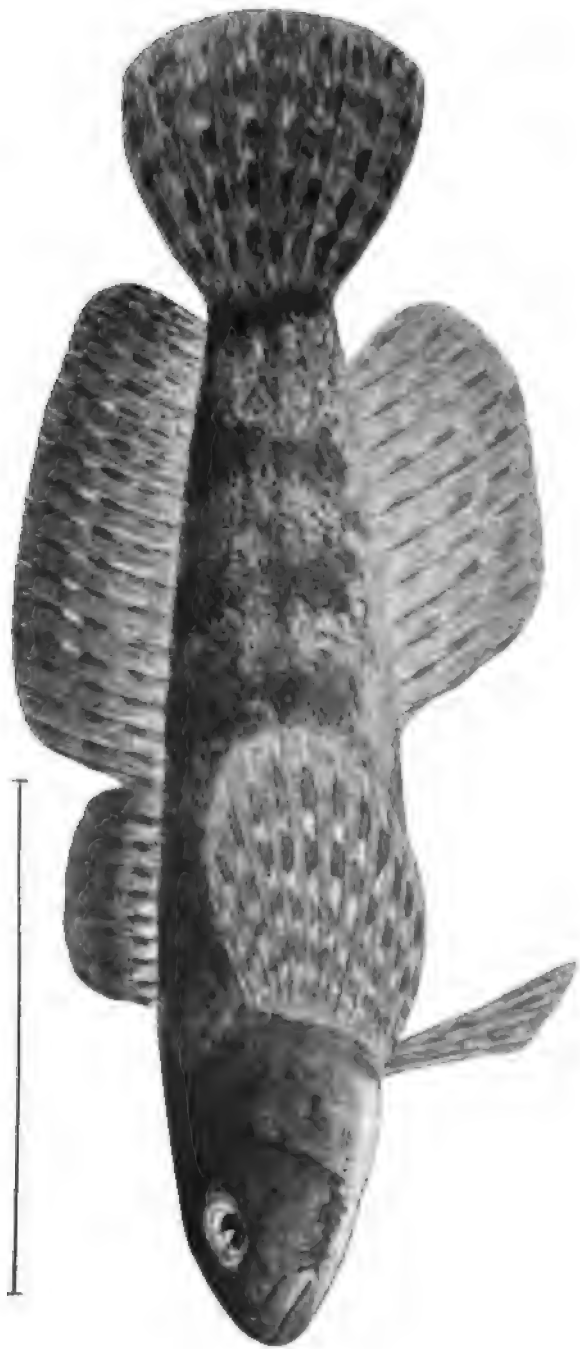


BLUE ANGEL FISH. *Angelichthys ciliaris* (Linnæus).

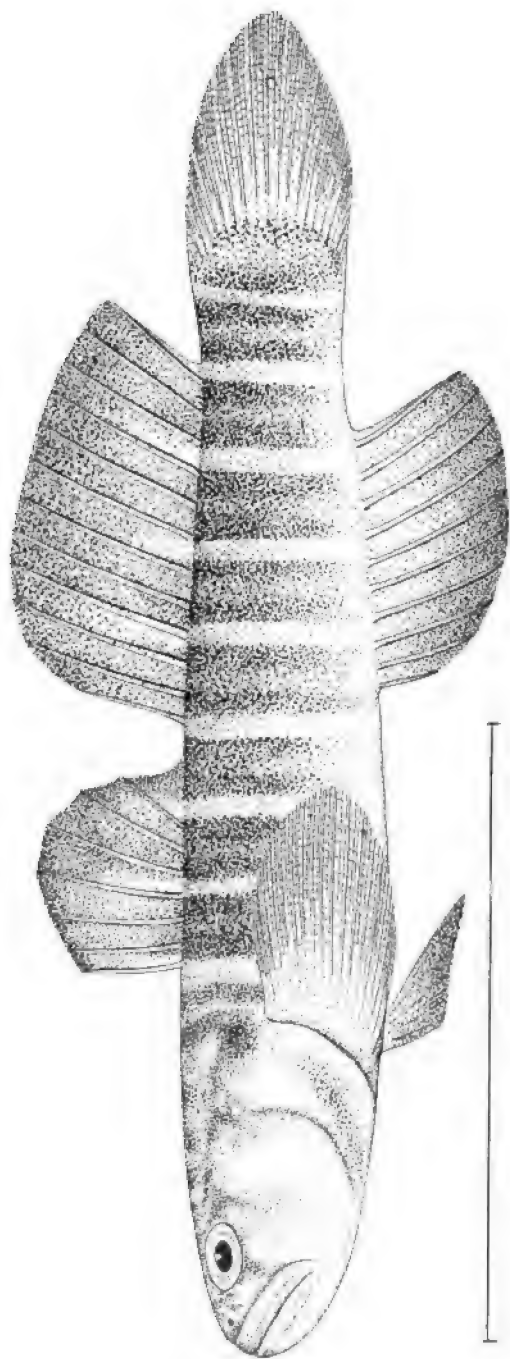


DOCTOR FISH. *Teuthis hepatus* Linnæus.

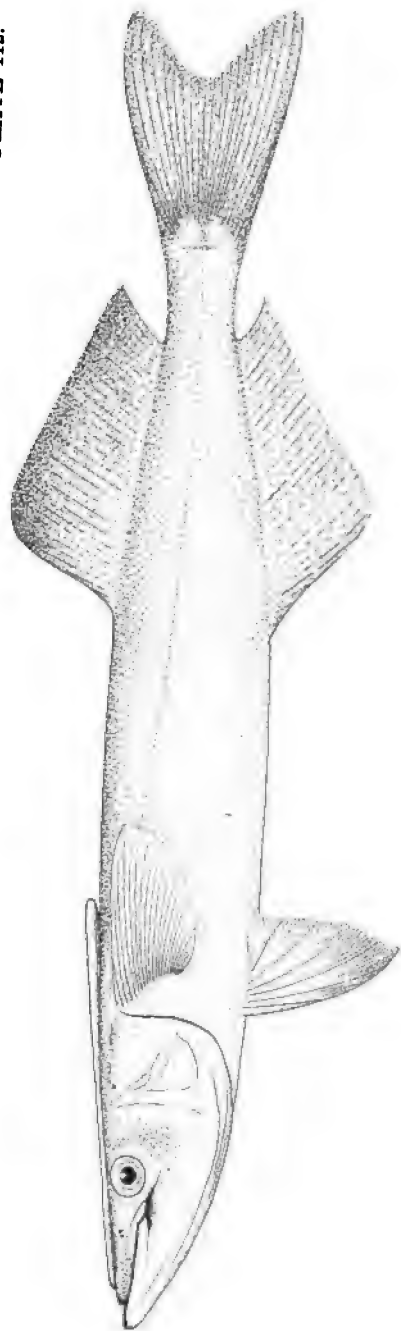
PLATE 110.



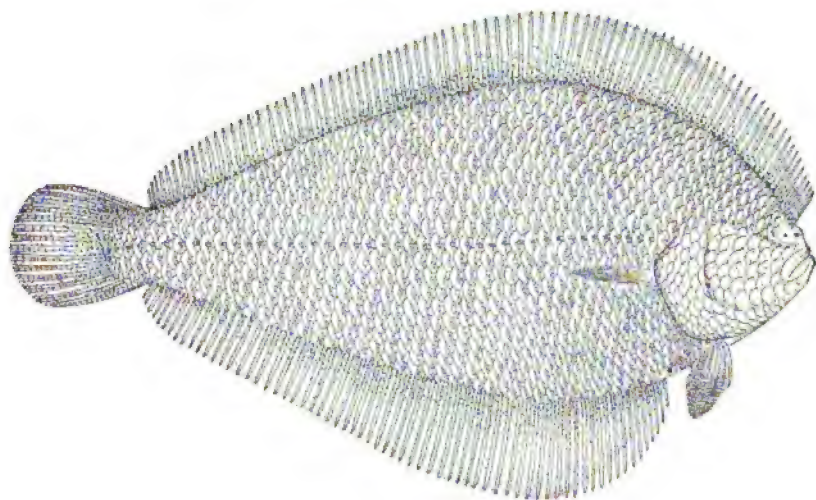
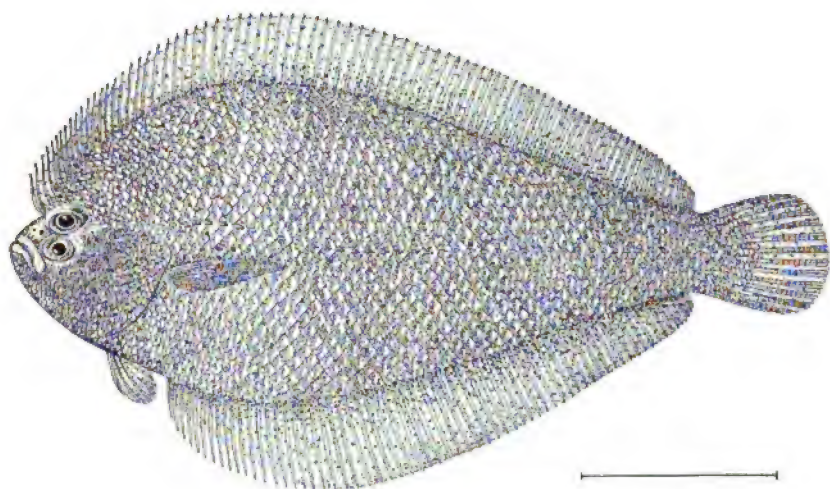
MILLER'S THUMB. *Uranidea gracilis* (Heckel).



NAKED GOBY. *Gobiosoma boscii* (Lacépède).

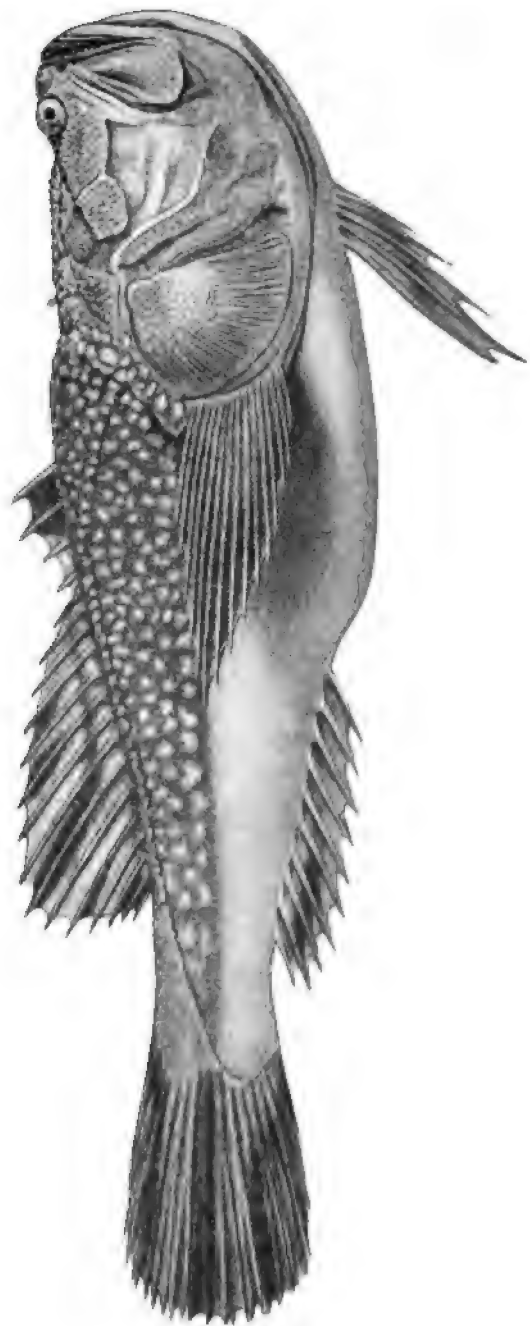


REMORA. *Remora remora* (Linnæus).

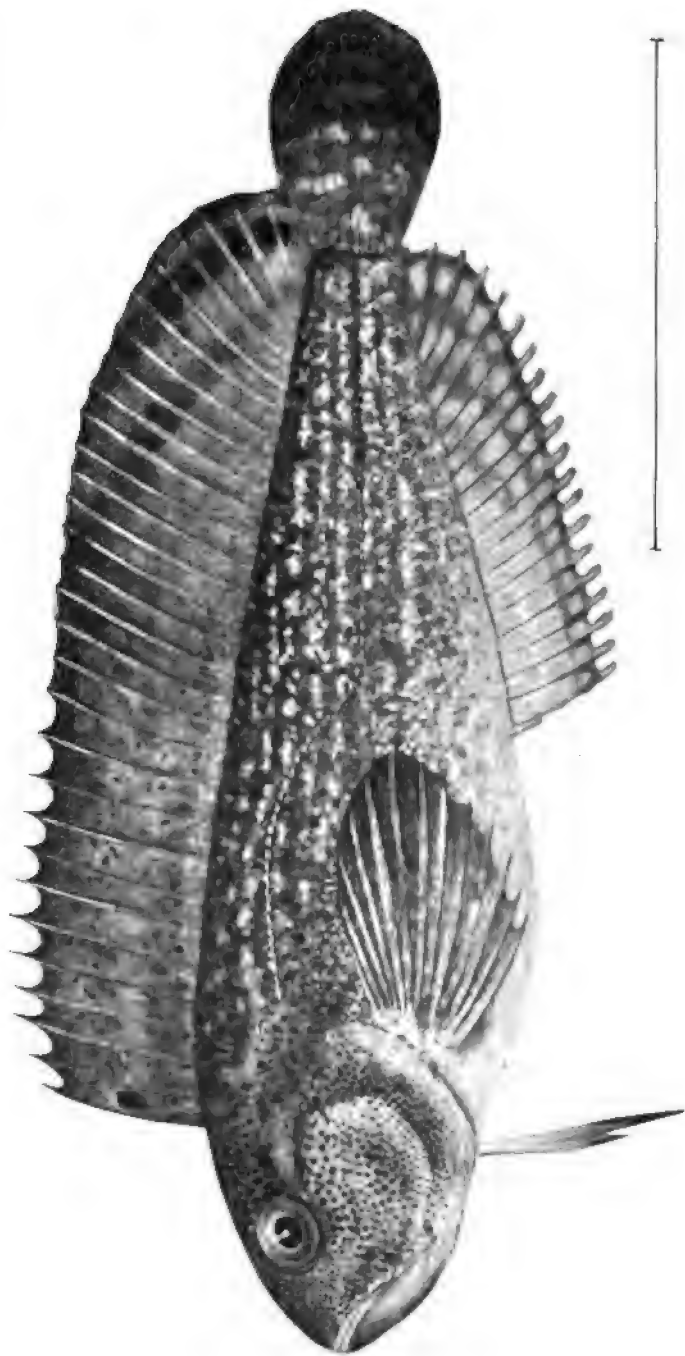


LITTLE FLOUNDER. *Etropus microstomus* (Gill).





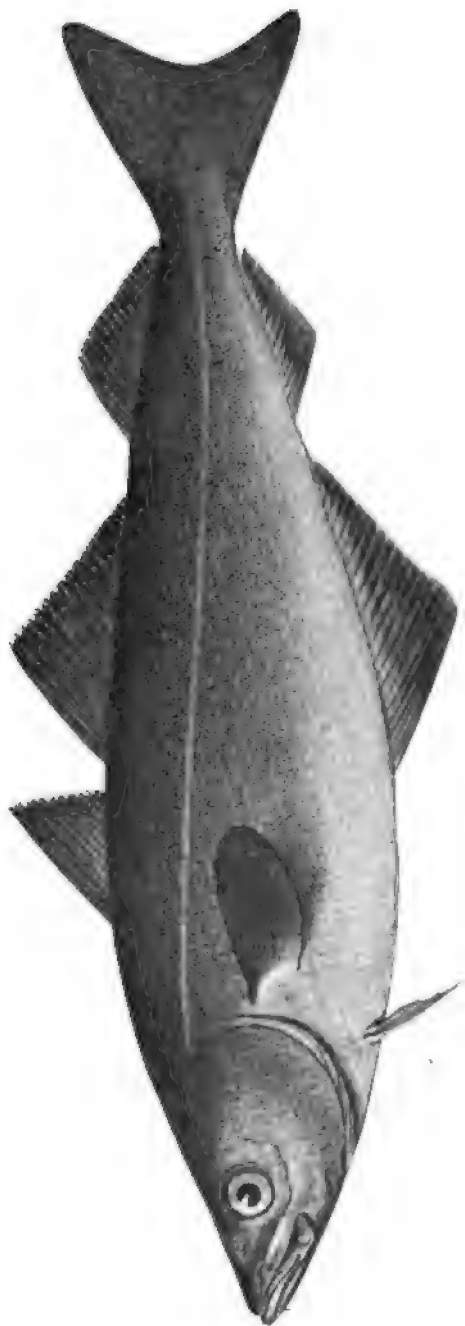
NORTHERN STAR GAZER. *Astroscopus guttatus* (Abbott).



SHELL BLENNY. *Hypoleurochilus geminatus* (Wood).



TOAD FISH. *Opsanus tau* (Linnaeus).

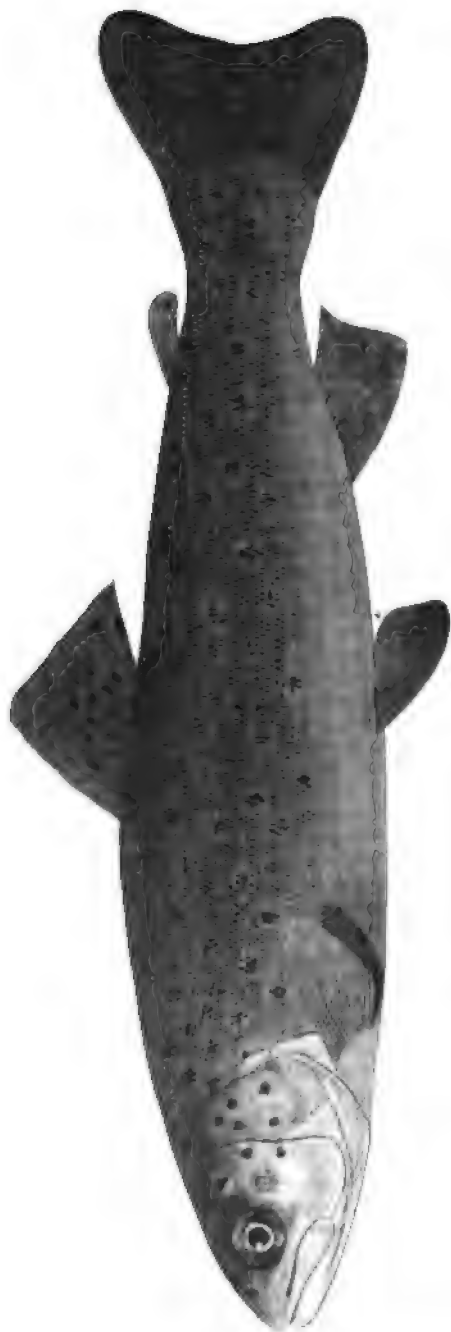


POLLOCK. *Pollachius virens* (Linnæus).

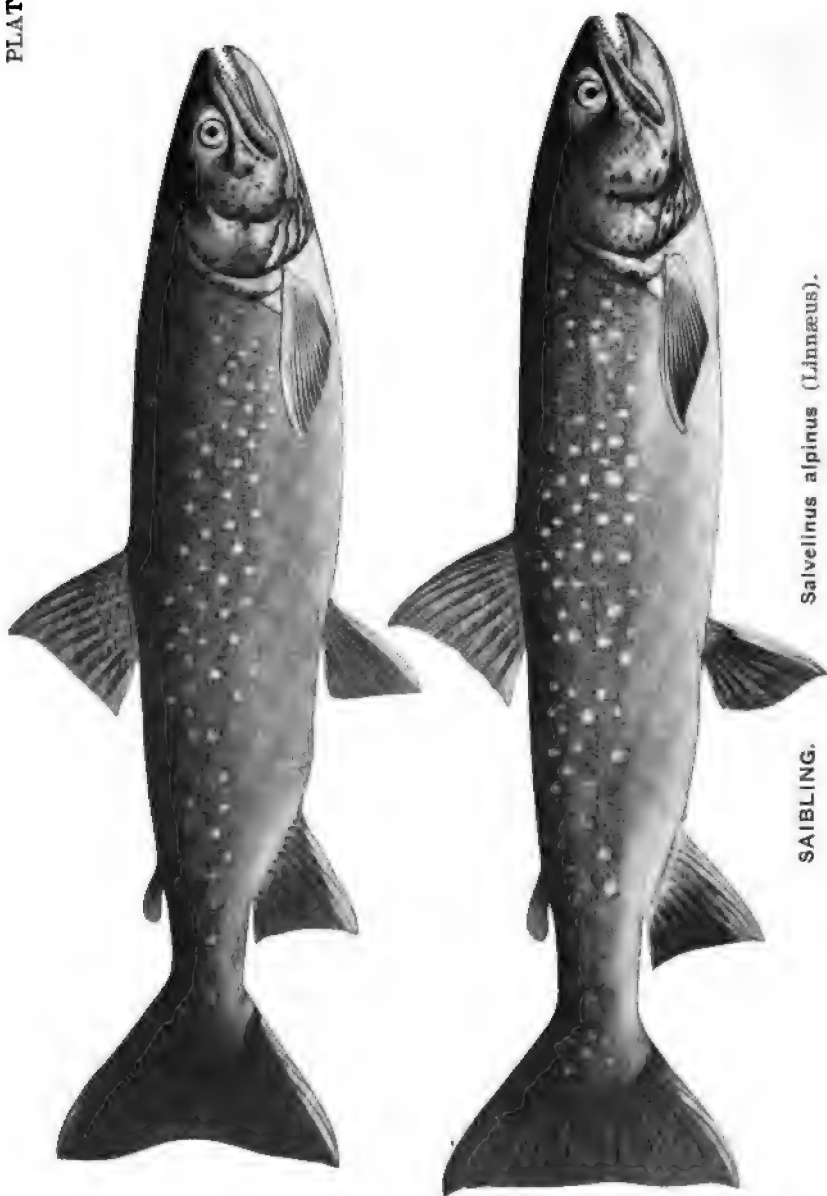


Pterophryne histrioides (Linnæus).

MOUSE FISH.



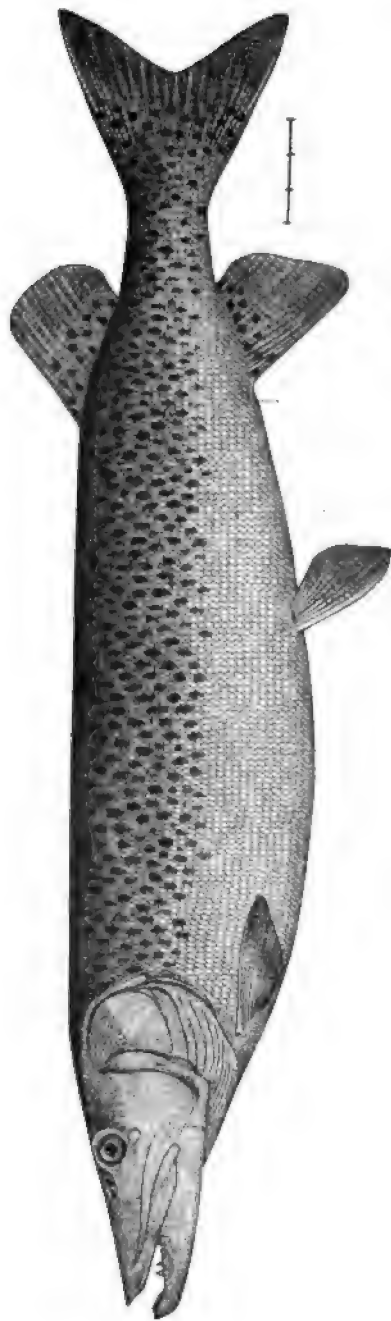
BROWN TROUT. *Salmo fario* Linnæus.



Salvelinus alpinus (Linnæus).

SAIBLING.





MUSKALLUNGE. *Esox masquinongy* (Mitchill).



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101

102

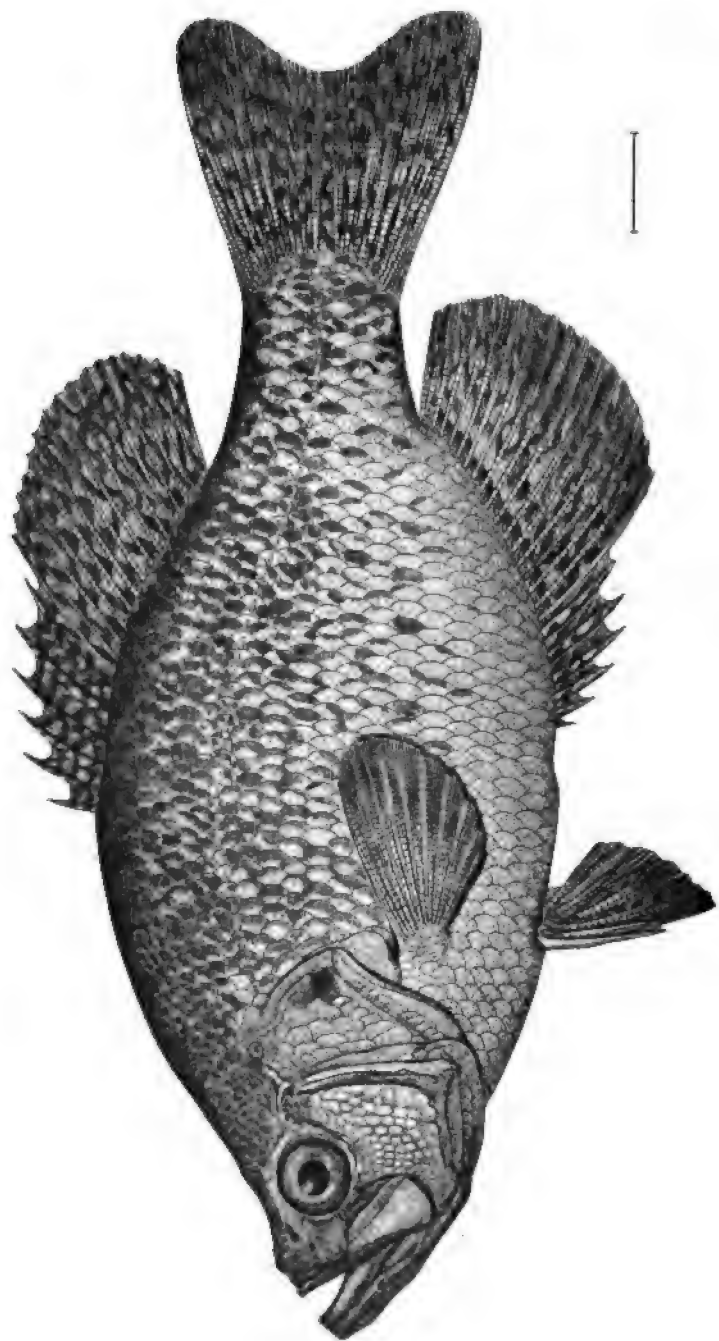
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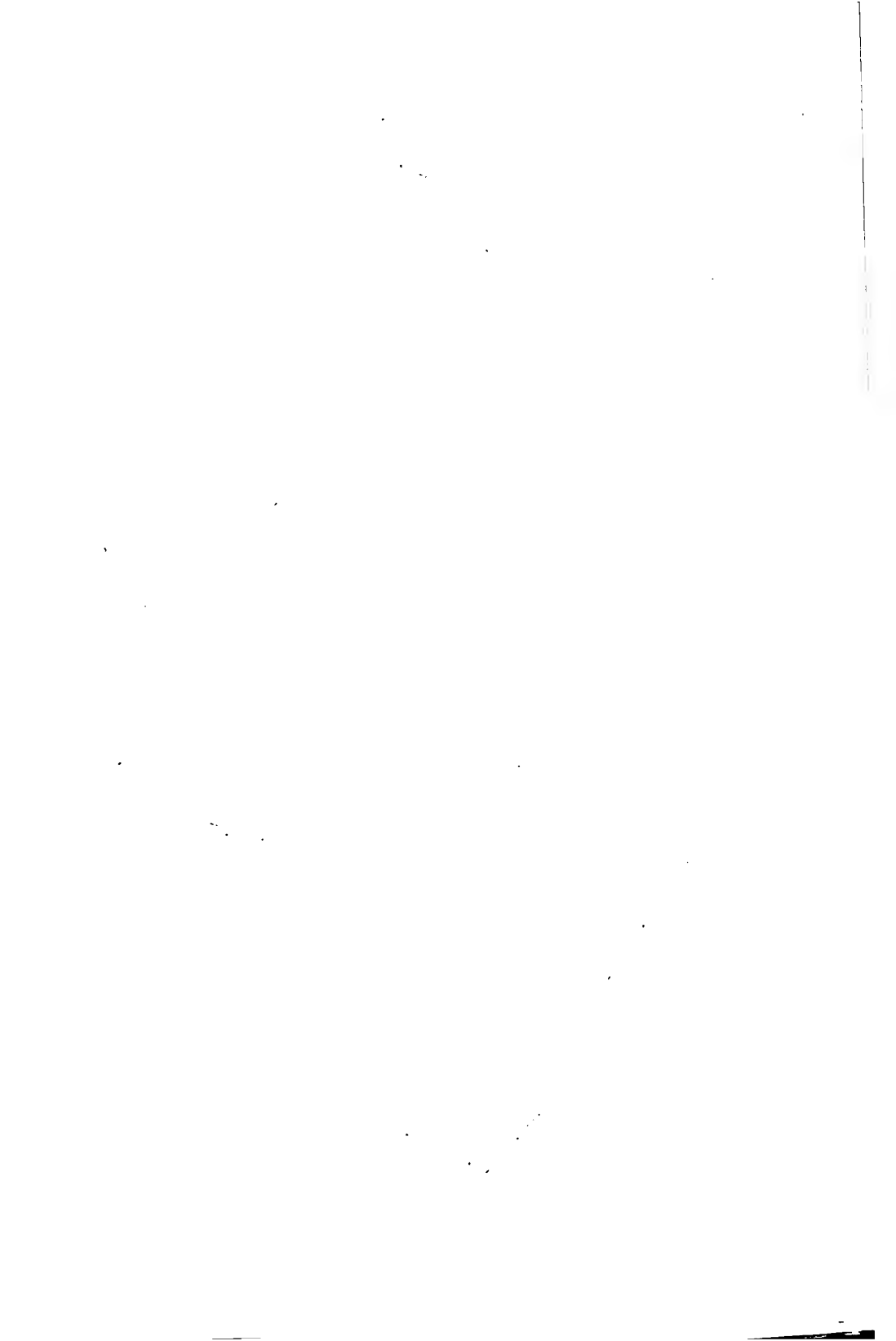
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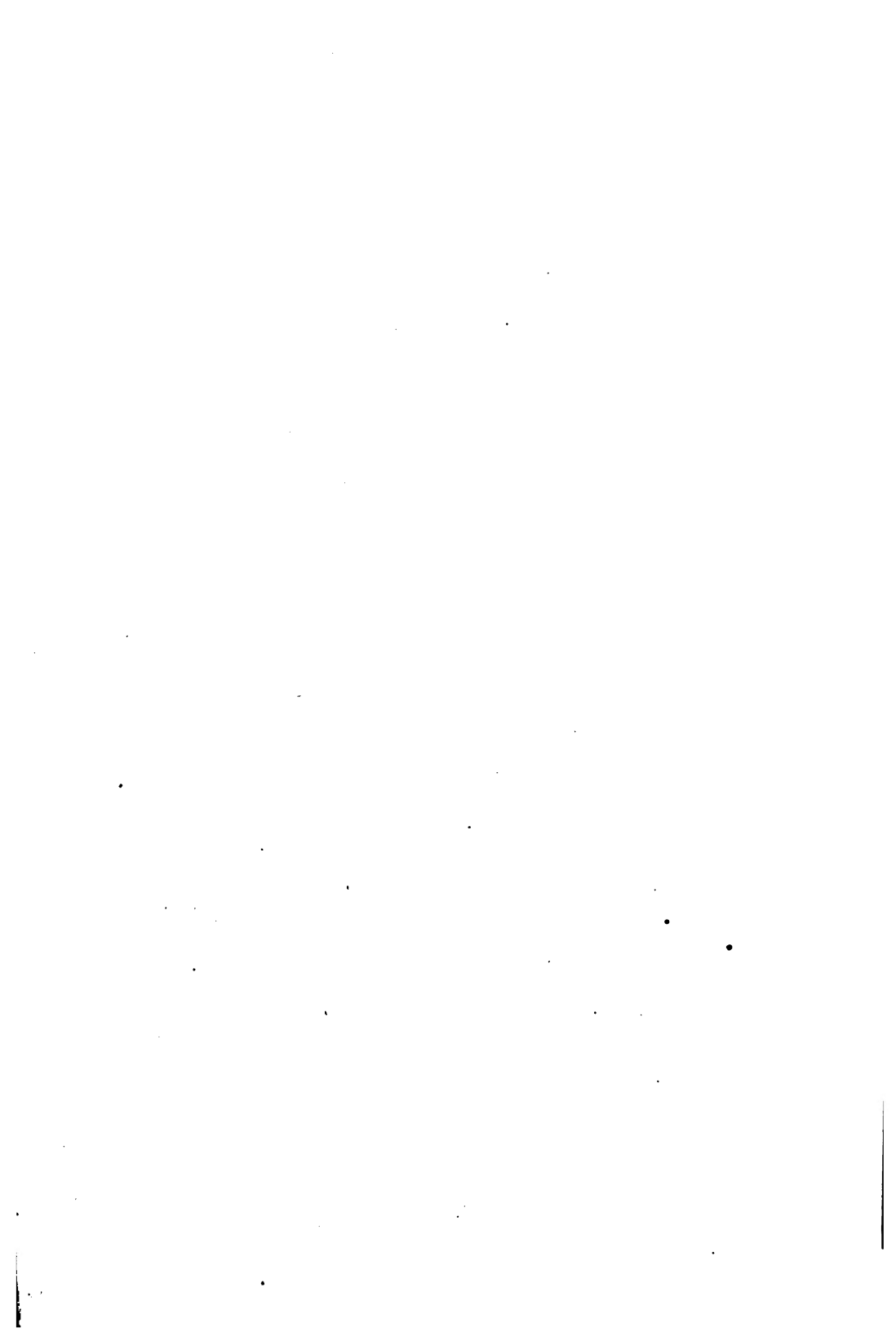


CRAPPIE. *Pomoxis annularis* Rafinesque.





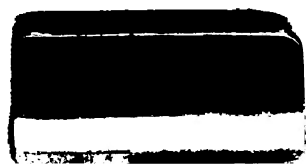




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